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ELECTRICAL PRECIPITATION OF CEMENT DUST.
BY PHILIP S. TAYLOR.

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Alphabetical Index to Advertisers, Page 8 Where to Buy It in the West, Page 9

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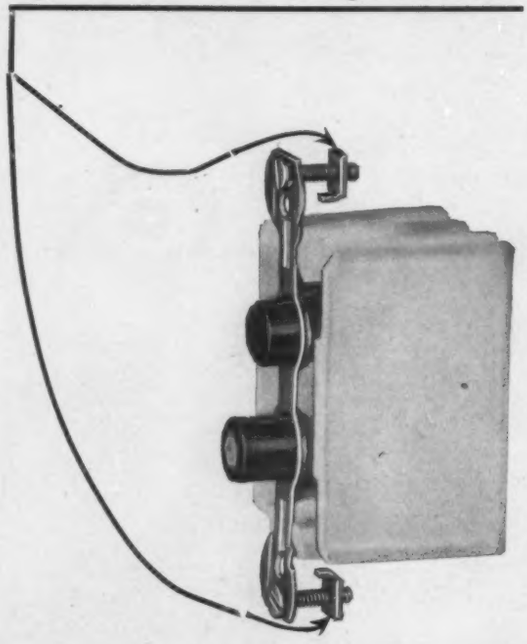

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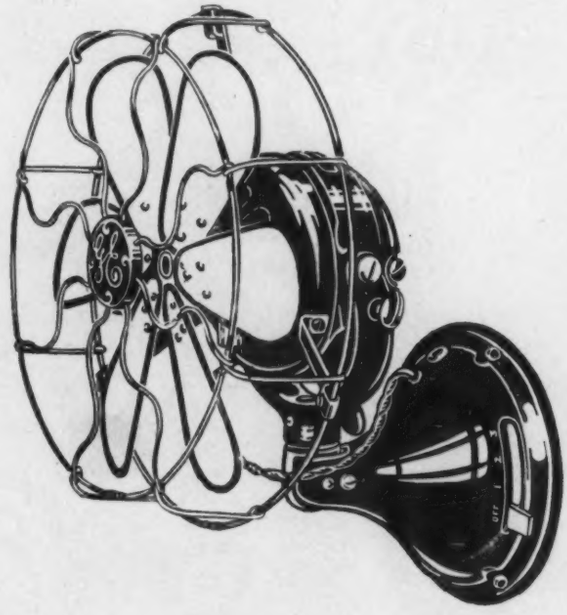

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ELECTRICAL PRECIPITATION OF CEMENT DUST

BY PHILIP S. TAYLOR.

(In this article is described a process of collecting, by means of high voltage unidirectional current, dust caused through the operation of rotary cement kilns which would otherwise escape and do damage to the surrounding country. The discussion, which is also included, gives added value, especially from a historical standpoint. The article was presented by Mr. Taylor before a recent meeting of the Los Angeles Section, A. I. E. E.—The Editors.)

This paper will deal with the collecting of dust escaping to the atmosphere from rotary cement kilns by means of the Cottrell precipitation system as applied at the works of the Riverside Portland Cement Company at Riverside, California.

Portland cement as manufactured at Riverside is a combination of lime-stone and clay materials ground to extreme fineness, usually so fine that 95 per cent will pass a sieve having 10,000 openings to the sq. in. This material is dry and in this condition is fed into the upper end of a rotary kiln at the rate of about 200 lb. per minute.

These kilns are 100 ft. long, eight feet in diameter and set at an angle of three-fourths of an inch to the foot. Fire, using crude oil for fuel, is applied at the opposite end of the kiln. The kilns are mounted upon trunions and rotate about one complete turn in every four minutes.

The materials in transit through the kiln meet the heat from the fire when at the proper time and heat—a chemical reaction takes place, the material sinters and clinker is produced. The combustion gases from each kiln equal an average of about 70,000 cu. ft. per min. at a temperature of about 550 degrees C. These gases carry some of the partially calcined material in suspension.

Early in 1909 investigation was started to determine a method of controlling the escaping dust and after carefully looking into various schemes which did not result in any practical solution of the problem, the services of Mr. Walter A. Schmidt were secured to conduct a series of investigations to adapt the Cottrell system to collect the material which was escaping.

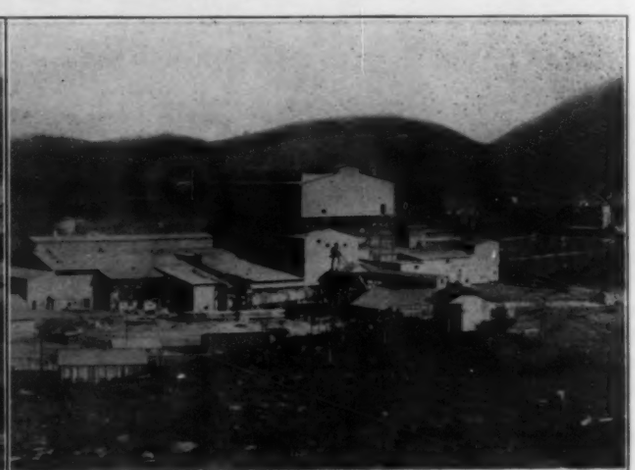
The problem, therefore, was to take gases at a temperature of upwards of 500 degrees C. and in quantity upwards of 70,000 cu. ft. per min. from each kiln, free these gases from dust, retain the dust for use and not interfere with the output of the kiln.

The system as developed after two years of almost unceasing work on the part of the investigators, consists of treating chambers, one on each side of each kiln stack. These chambers are 13 ft. wide 18 ft. high and 38 ft. long. In these chambers are arranged the discharge electrodes and the collecting plates. From the discharge electrodes to the collecting plates a high voltage unidirectional current is maintained, setting up a strong electrical field.

To obtain this high voltage unidirectional discharge, current from a motor driven alternating current generator is stepped up from 220 to 60,000 volts and then by means of a rectifier, designed specially for this work, and driven from the same shaft that drives the generator, the current is changed from alternating to unidirectional. This rectified current has a mean value in the treaters of about 37,500 volts.

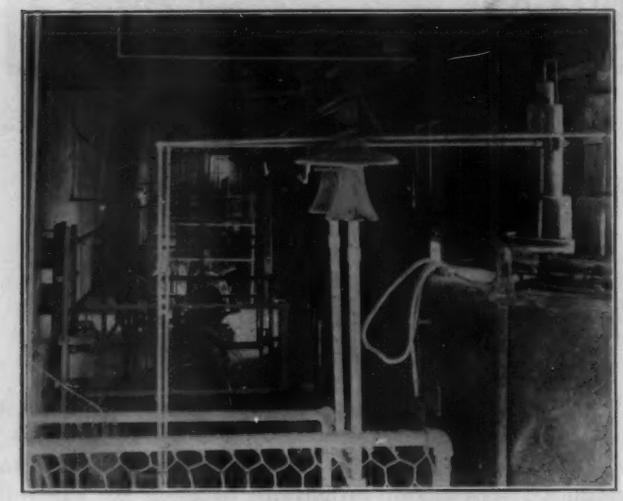
The underlying principle upon which the system

General View Showing Exit Gases Before Treaters Were Installed.



Same View Showing Small Amount of Exit Gases After Treaters Were Installed.

is based consists of bringing the dust laden gases into an electrically charged field which is maintained by means of a negative silent or glow discharge. On account of this discharge, the path through which the



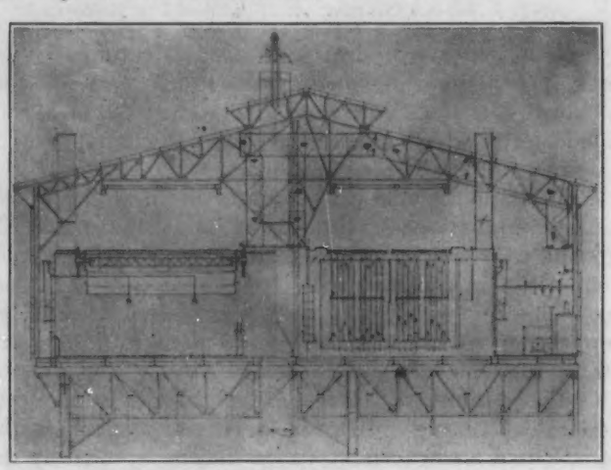
View of Rectifier Room.

dust charged gases travel becomes filled with gaseous ions and the dust particles in transit through this space become charged by coming in contact with these ions. These particles then travel in the direction of the field and are deposited upon the collecting plates. Thus the dust is drawn out of the gases and the gases themselves go on their way without hindrance.

This entire installation is made at the top of the kiln stacks, eighty feet from the ground and consists of twenty chambers or treaters, two to each stack. At the entrance to each chamber are arranged dampers which are controlled by air cylinders. Dampers are also provided at the exit. Once each hour these dampers are closed and the collecting plates thoroughly cleaned by shaking, which is done by means of air hammers which are connected to the plates. The material which is shaken from the plates is collected in hoppers from which it is taken by means of screw conveyors to its individual automatic weighing machine where the weight is recorded.

The discharge electrodes consist of No. 20 B. w. g. soft Norway iron wire and are suspended from a frame which is mounted on four sets of insulators, one set at each corner which consist of a natural stone from Catalina Island. This material is a serpentine and has the property of being a very fine insulator at high temperature. It also has the added quality of having great strength. The openings through which the high tension system frames pass, are also closed with the same material.

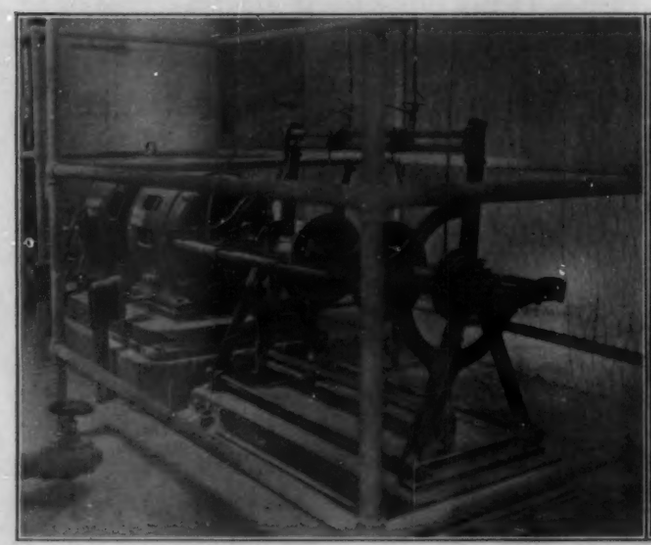
The collecting plates are made of wire screen of eight mesh number 14 wire reinforced every foot with one inch by one inch angles. These plates are spaced one foot apart and are placed longitudinally with the treater. The discharge electrodes are in turn placed between these plates and are also spaced one foot apart, thus giving a series of discharge points to every foot square of the chamber.



Section Through Treater.

Some dust adheres to the discharge electrodes. This is shaken off each hour by means of a few light blows with an insulated hammer on the suspension frame.

The gases enter the chamber without any previous cooling at a temperature of about 550 degrees C. In passing through the chamber the velocity is reduced to about ten feet per second and the gases lose about one-half of their heat, the exit gases having a temperature of about 250 degrees C.



Motor Generator Set and Rectifier at Rest.

Rectifier in Motion. Note the Sparks.

The amount of current to operate the system varies from 3½ to 4 kw. per treater. This includes all the power required to drive the motor-generator and conveyor.

The labor of operating is easily taken care of by two operators on a shift. There are two shifts daily.

The material reclaimed is in condition to be returned to the kiln bins and used for making clinker.

It has been found, however, that owing to the alkali content of the clay used, that the materials have considerable value as a fertilzer and large quantities have been used for that purpose.

Tests for efficiency have been made, using three methods and over long periods, the results of which have shown an average clearance of upwards of 97 per cent. A large part of the small portion which escapes is undoubtedly volatilized potash which does not condense until it reaches the cool air.

The system has been in continuous operation since January 8, 1913, with no interruption nor does it show any signs of deterioration. The application of the system has in no way interfered with the operation of the rotary kilns, in fact it has resulted in putting the control of the kiln in a more flexible condition than before. Natural draft is used and is controlled by means of the dampers into the precipitation chambers.

In order to accurately measure the effective potential in the treaters, a guard ring electrometer was developed which reads the unidirectional current potential direct, without the use of any shunts or resistances. This is an interesting instrument and is here illustrated.

It has been observed in the operation of the system that as the gases increase in temperature, their dielectric strength increases; that is, the higher the temperature the greater the potential required to maintain a given amount of current flow through the gases. This is in opposition to the findings of Prof. Ryan in his work on the dielectric strength of gases. In these gases the critical point for corona discharge seems to be reached at about 20,000 to 22,000 volts.

A rather curious phenomena appears in the outlet gases as they make their exit. A considerable charge is retained and by exploring with a conductor and a static voltmeter, this charge appears to have a value of about 10,000 volts.

Gang Ring Voltmeter.

For the purpose of protecting the structure from excessive temperature, thermo-electric couples are placed in the gases in the stacks. These couples, by means of a delicate galvanometer and pen, make a continuous graphic record of the temperature of the gases.

From the results obtained and maintained for the past year, it would appear that the materials recovered would about make the system self-sustaining and that a very difficult problem has been satisfactorily solved.

DISCUSSION.

Harris J. Ryan (by letter): I am glad to have had this opportunity to read Mr. Phillip S. Taylor's interesting and valuable paper. I have to place this note of comment and copy of his paper in the mail within the hour of its receipt. I can refer, therefore, only to the point the author makes in regard to the conduction of the dust laden gases in relation to voltage and temperature.

The author has found that increased voltage is required to maintain a given current through the dust laden gases at increased temperature. Such result is undoubtedly correct. His knowledge of these matters and facilities for studying them enable him assuredly to arrive at correct results.

Such result, is, however, not at all in conflict with the results found by me and authenticated by Watson Peak and Whitehead, viz: that the voltage required to short conduction in the normal comparatively dust-free atmosphere diminishes as the temperature of the air increases. From such result one can not predict, however, the relation between the temperature of a dust laden gas and the voltage required to maintain a given amount of discharge current through such gas. One could not even predict, with a certainty, that the voltage which maintains a given discharge current should increase or decrease with increase of temperature. Nevertheless these matters are related all around. In the dust conduction case the factors are numerous and many of them not well understood, while in the short-of-condition in an ordinarily clean gas the factors are few and their relation well understood. Mr. Taylor's observations are new and of value, though not in conflict of our well authenticated understanding of the relation of critical corona voltage to temperature.

Walter A. Schmidt: There is so little in Mr. Taylor's paper which required comments from me, that when asked to take part in the discussion of the paper, I insisted that there is nothing of value that I could add to Mr. Taylor's own discussion of the technical questions. He and I worked together upon the entire investigations conducted at the factory of the Riverside Portland Cement Company, and Mr. Taylor is quite as familiar with all of the details of this work as I am. I did promise, however, to tell of a few of the more recent applications of the processes, provided this would be of interest to the members of the Society.

The facts as presented by Mr. Taylor are not directly in conformity with the results of investigations carried on by other investigators. The letter which has been received from Prof. Ryan, and which was read a few moments ago, shows clearly that in the investigations which were carried on in our work, we dealt with conditions not exactly comparable with those under which Prof. Ryan and other investigators conducted their measurements. The phenomena which Mr. Taylor speaks of in his paper is the result of two independent factors:

1st: The change in dielectric strength of the gases with a change in temperature.

2d: The effect of introducing particles into the field.

With a clean gas the dielectric strength of the gases decreases with a rise in temperature. The introduction of particles, however, brings about an opposite effect. Through the electrical charge which these particles assume, the introduction of a large number into the space between the electrodes instantly changes the characteristics of the field, bringing about what might be called a "banking up" effect. This results in a decrease in the field intensity at the surface of the discharge electrode with a resultant decrease in ionization, and an apparent increase in the dielectrical strength of the gases themselves. We have made no exact measurement of this phenomena as it is rather a difficult question to deal with experimentally. We are planning, how-

ever, to carry through a systematic investigation of this phenomena in our laboratories within the near future. The facts as presented by Mr. Taylor are not to be taken as evidence in opposition to the investigations carried on by Prof. Ryan and other investigators, but they well illustrate how the changing of one factor in a composite phenomena often changes all of the characteristics of the phenomena itself.

A brief review of the development of the electrical precipitation processes may be of interest to you gentlemen. The fundamentals of these processes are not entirely new. The first actual work upon this method of removing suspended particles from gases, and of which we have any record, was conducted by Sir Oliver Lodge in the early '80's. He conducted extensive laboratory investigations and definitely showed the possibilities which this method of cleaning gases possesses. He later attempted to apply the idea upon a commercial scale and conducted with his co-workers, a series of tests in the flues of a lead works. In these the discharge electrodes consisted of barbed wires. The experiments, however, proved a complete failure. It is undoubtedly true that the main reason for failure was due to the inadequate electrical generating apparatus available at that time. All the experiments were conducted with Wimshurst machines, which, although capable of producing the required potential, were unable to supply sufficient power to bring about an adequate discharge from an extensive system of electrodes. About the same time that Sir Oliver Lodge carried on his investigations in England, Dr. Karl Moller conducted similar investigations independently in Germany. The results of Dr. Moller's investigations also proved futile.

It seems that no further work was done along these lines, after the early investigations, until 1906, when Dr. F. G. Cottrell was investigating methods and processes for the purification of sulphuric acid gases, in connection with the contact processes for the manufacture of sulphuric acid. He soon devised means for generating the high potential direct current required for this work. The first commercial work was done at about 10,000 volts, at which time the main problem consisted in developing the various forms of electrodes required to bring about an adequate discharge using this comparative low potential. The general question of treater design, the development of methods and means for collecting and holding the precipitated material, necessarily presented all the worries and vexations incident of the development of any new process. The first commercial application of the processes was the collection of sulphuric acid mist. The first commercial installation was made in 1907, and this plant has been in continuous operation ever since. From this early work the application spread from one thing to another, covering the general range of sulphuric acid laden gases as encountered in metallurgical plants, the general collection of flue dust, etc. It was not until 1910 that the question of collecting cement dust was brought to our attention. Here we encountered absolutely new conditions, consisting primarily in the high temperature of the gases, the complete dryness of gases and the large quantities of non-conducting dust which had to be collected and disposed of.

Since the first experiments conducted by Dr. Cottrell the generation of high potential direct current has been continually extended to higher values. The installation at Riverside operates at approximately 40,000 volts, and the last work which we have conducted in the metallurgical plants was with direct current at a potential approximately 75,000 volts. No difficulties have been encountered in either generating or applying this high potential.

Referring to Mr. Lighthipe in his statement that the application of the electrical precipitation processes have been made commercially profitable at the works of the Riverside Portland Cement Company through the recovery of valuable products formerly lost, I wish to state that the major question at the cement factory was not that of recovering valuable materials but was a problem of overcoming a nuisance feature. The farmers in the adjacent country declared that damage was being done to the orange groves. Whether this is actually true has never been proven, in spite of the fact that thousands of dollars were spent in the lengthy court fight between the farmers and the Colton cement factory, in the course of law suits covering several years. The problem is therefore to be looked at as a nuisance question rather than one of damage to the surrounding territory. The material which was formerly lost from the cement factory is not cement, but consists of a partially calcined raw mix. At Riverside the raw mix consists of a mixture of limestone and rotten granite, the granite being high in potash feldspar. The material caught in the electrical treaters consists of a partially calcined raw mix, being possibly 50 per cent calcined, and in addition contains considerable quantities of potash salts, these being the result of decomposition of the feldspars in their passage through the rotary kiln, the votilization of the potash with subsequent sublimation and collection in the electrical treaters along with the dust. The material collected, although not a valuable product in comparison with finished cement, is valuable as a basis for the manufacture of cement, and also as a soil dressing for fertilizer purposes due to its lime and potash content. Quantities have also been used as a "filler" for asphalt paving. The fact that the material collected at Riverside has proven sufficiently valuable to make the installation self sustaining, has been a source of gratification to us all.

The more recent applications of the processes practically all deal with the recovery of the valuable flue dusts, where the recovery of the dust itself constitutes a large financial profit. These installations are all in the larger metallurgical plants. In one of these plants it is estimated that the material collected will have a net value of a quarter of million dollars per year.

Slides were then shown illustrating a number of applications to the metallurgical field and also illustrating the collection of carbon smoke at Pittsburg.

Dr. H. W. Morse: In connection with the theory of precipitation it might be interesting to mention that we have tried experiments in the laboratory with quite large objects. Using a brass plate about 4 ft. long as positive electrode and a small wire about 8 in. from it as discharge electrode, small steel bicycle balls are easily deflected through a considerable distance. For a fall of 8 or 10 ft., passing the 4 ft. plate about half way in its path, a steel bicycle ball is deflected by a field of 20,000 volts or so nearly 3 in. out of vertical. It seems evident from these and similar experiments that what we ordinarily understand by ionization is only one of several factors which may influence the precipitation of dust particles. No accumulation of ions within our experience would account for the force which acts on these steel balls. It seems very probable that three factors at least are effective and that these act in varying proportions, depending on the size of the particle to be moved. For very small particles, gaseous ions may accumulate in sufficient number to cause a motion of the particle in the field. As the size of particle increases, this factor becomes less important and for larger masses it may be that electrostatic induction, or some other field distortion, would account for the force. A great many experiments have shown that what has been called electric wind may be a factor of considerable importance in producing the motion of particles.

(Mr. Wesley Beach, one of the attorneys who conducted the injunction suits for the Orange Growers against the California Portland Cement plant at Colton, California, being present, was invited to comment on the paper from the standpoint of the Orange Growers.)

Wesley Beach: I am intensely interested in the subject of this paper, but I did not come prepared to take part in the discussion. For the past five years I have devoted a large part of my time to furnishing the inspiration for the conduct of the experiments which have just been described. Mr. Walter Schmidt has modestly disclaimed being the father of this invention, sharing the glory with the other gentlemen who have spent so much time and energy in working out these problems. I have not contributed any of the gray matter employed in their solution, but if necessity is the mother of invention, I think I may lay some slight claim to parentage, or relationship at least, to this invention, on the maternal side.

About the time that Mr. Schmidt commenced his experiments at the plant of the Riverside Portland Cement Company, I was engaged in the trial of the injunction suits against the California Portland Cement Company at Colton. The trial occupied about ten weeks in the superior court of San Bernardino county and hundreds of witnesses were examined, including experts in nearly every branch of science from chemistry and botany to ornithology—I believe the baleful influence of cement dust upon even the bird life of the community came in for mention.

There are some facts which might be mentioned which are most interesting, from the standpoint of the layman, and that is the standpoint from which I am accustomed to view the situation, although from having spent my boyhood amid the citrus industry, and having assisted in cultivating and caring for some of the orange orchards in the so-called "dust zone" of the cement plant at Colton, and later as teacher of chemistry in the Colton High School, where I used to take the chemistry class through the mill of the California Portland Cement Company as a demonstration of the application of industrial chemistry, I gained some insight into the technical side of the problem.

The old cement plant at Colton has been in operation for about twenty years; formerly it was a small affair, operated only intermittently, and little damage was done outside of the radius of a few hundred feet, but in 1908 the company built a new mill, with several times the capacity of the old mill, and very soon after its operation was commenced it became apparent to all the residents of that community that very serious damage was being done by cement dust. Within three months after it commenced operation every solar heater in the town of Colton was put out of business; nothing but acid would remove it from glass, and within a few days it would be as bad as before. The trees and buildings began to assume the appearance of an ash heap. The cement dust was very tenacious and could not be washed off or removed from the foliage or other objects upon which it settled. The orange tree was peculiarly susceptible to damage from the dust for the reason that the orange leaf remains upon the tree for from three to five years, and the coating of cement dust upon the leaves of the orange trees became constantly thicker with the lapse of time.

At the time the suits were commenced to enjoin the operation of the Colton plant, the company believed, and the evidence at the trial indicated, that the difficulties in the way of the control of the cement dust were insurmountable. According to the most reliable data that could be secured from various plants throughout the United States at that time, it was estimated that the Colton plant was losing from ten to twenty tons of partly burned raw mix per day in the dust discharged from its chimneys. Subsequently, when a system of dust control had been installed at the Colton plant, it was found that they actually caught and saved in their treaters sixty tons of dust per day, and that with a greatly reduced draft through the kilns, so that it is safe to say that a very much larger quantity than that amount was formerly discharged out of their stacks daily. This dust settled upon the surrounding territory in quantity sufficient to cause damage for a radius of several miles. The cement company's plant represented a very large investment and the surrounding territory included some of the highest priced farming land in the world. Both sides went in to the legal battle believing that the result would be destruction for one side or the other. In fact when the supreme court rendered its decision approving the injunction, the door of hope for the solution of these problems was just beginning to open. Subsequently the Colton plant completed the installation of a system of dust control on a different principle from the one described here, and while there is still some difference of opinion betewen the company and the growers, as to the absolute efficiency of the device, the results attained are so promising that an end of litigation is in sight.

The conditions surrounding the Riverside Portland Cement Company when they commenced to operate their plant, in Riverside county in 1910, were very similar. The plant was much larger than the one at Colton; the dust zone included thousands of acres, and the lands in it were very valuable. The problem of controlling the dust was new, the difficulties enormous, and the time for solution short. The company promised to proceed with all diligence to abate the dust nuisance but the deposit of dust was so enormous, and the damage from it so great, that the farmers were threatened with quick destruction, and they were compelled to put in motion the wheels of justice in order to secure quick action if the experiments which the company had undertaken at great cost, should fail.

I understand that the tests for efficiency mentioned by Mr. Taylor were made within the plant. Sufficient time has not elapsed to measure its efficiency by the results upon the neighboring farms. The trees still carry the burden of dust from former years. The farmers hope fervently that the company will be absolutely successful and these gentlemen have earned a large measure of glory for the energy and boldness with which they have attacked this problem and for the degree of success which they have thus far attained.

We have about fifty injunction suits pending against the Riverside Portland Cement Company in Riverside county, which we shall be very glad to dismiss when it has been conclusively demonstrated that the dust nuisance has been abolished.

Electrical atmospheric charges for the benefit of crops, have been used extensively in experiments by Sir Oliver Lodge. A positive charge was applied which acted as a supplement to the positive charges caused by the sun, and the increase in the yield of the crops in this way amounted to as high as 30 per cent. No increases were, however, recorded during 1911, a year of drought in which the atmospheric charges were sufficient due to the effect of the sun alone. The charge was applied over the crop area to be treated by means of No. 11 wire supported and insulated on poles 16 ft. above the level of the ground; between these, cross lines of No. 24 wire were stretched. The pressure used was 100,000 volts. It was found possible in this manner to increase the electrically charged state of the atmosphere to 10,000 times the normal. There was reason to believe that certain plants of a leguminous kind would thrive better on the application of a negative charge.

ELEMENTS OF FUEL OIL PRACTICE AND BOILER TESTING

BY ROBERT SIBLEY.

Units.

Fable has it that Sir Isaac Newton, when a boy in England, lying one day under an apple tree and gazing upward, saw an apple fall to the ground. The contemplation of this phenomenon lead Newton to give to the world three fundamental laws upon which modern engineering is built. Briefly stated these laws are as follows:

Law 1. Every body continues in a state of rest or a state of uniform motion in a straight line except insofar as it may be compelled by force to change that state.

Law 2. Change of motion is proportional to impressed force and takes place in the direction of the straight line in which the force acts.

Law 3. To every action there is always an equal and contrary reaction; or the mutual actions of any two bodies are always equal and oppositely directed.

A force is said to be acting, then, according to Law 1, whenever the physical conditions are such that velocity is changed in magnitude or direction. Thus, when a train of cars is started or stopped, a force is necessary to cause this phenomenon, and this is evidently a change in the magnitude of the velocity. On the other hand, in the rotation of a fly wheel, the velocity may change solely in direction without a change in magnitude, and yet a force be necessary to maintain its parts in equilibrium. Hence a force may be considered as a push or a pull acting upon a definite portion of a body. Such a push or pull always tends to change the motion of the body; but this tendency may be counteracted in whole or in part by the action of other forces. In the latter instance the force is usually denoted as pressure, and it is the consideration of this latter case, or the consideration of pressures, that will largely concern our attention in the generation of steam in a boiler.

In considering Law 2, it is seen that there is some inherent property in matter that makes it difficult to set in motion. Physicists have defined this quality of matter as being the inertia of a body. Inertia is expressed quantitatively in engineering practice in terms of its mass, which is measured in pounds. In order that these quantities, force and mass, now introduced may be quantitatively measured, it is necessary to have some fundamental units upon which to base our computations. Three units only are fundamentally required; namely, a unit of length, a unit of mass, and a unit of time. Scientific practice has deduced for these units the centimeter, the gram, and the second, which are well known and need no further illustration. In engineering practice, however, especially among English-speaking people, the foot, the pound, and the second seem to be in almost universal usage. We shall consequently largely express our deductions in terms of these latter units.

Having now decided upon the three fundamental units of measurement, let us look into other fundamental definitions and secondary units to be employed.

Since engineering science must deal with motion and the change of motion per unit of time, it is necessary that we have units wherein to measure them. Change of motion per unit of time is known as velocity and is expressed in feet per second. A change in motion may, however, be undergoing a change, and this phenomenon is known as acceleration, which is measured by the change of velocity in feet per second.

Since a force **P** is fundamentally defined as being proportional to the change in motion of a body, it follows that a force is equal to a constant, **M** multiplied by the change in motion, or, in other words, multiplied by the acceleration, **a**. Hence

$$P = Ma \quad \ldots\ldots\ldots\

The mention of the words "per minute" in the last statement now indicates to us that the time taken to perform a given quantity of work in engineering practice is of vast importance. Consequently this fact necessitates still another unit of measurement, namely that of power. Power is defined as the time rate of doing work. The horsepower is the basic unit. When 550 ft. lb. of work are performed per sec., or 33,000 ft. lb. per minute, a horsepower is said to be developed. Hence, since in the above engine cylinder **PLAN** ft. lb. per min. are being developed, the horsepower is computed as follows:

$$\text{h. p.} = \frac{\mathbf{PLAN}}{33000} \qquad (2)$$

Thus in Alameda, California, a certain Deisel oil engine has a piston area of 37.7 sq. in., a stroke of 1.5 ft., a mean effective pressure of 23.36 lb. per sq. in., and each cylinder makes 125 working strokes per minute. Hence each cylinder develops.

$$\text{h. p.} = \frac{23.36 \times 1.5 \times 37.7 \times 125}{33000} = 50.0$$

Under the heading of "Rating of Boilers" in a succeeding chapter the particular power units employed in steam engineering practice will be considered in minute detail, such, for instance, as the horsepower, the boiler horsepower, the force de cheval, and myriawatt.

Another important consideration is that of the physical characteristic of a body which enables it to perform work. This physical quality possessed by a body which enables it to perform a definite quantity of work is spoken of as its energy. Energy then is the capacity for work. In general we meet with two great classes of energy. One is that of kinetic energy, or energy of motion. According to Law 2, if the motion of a body be changed, a force is required. Hence a body actually in motion possesses kinetic energy. The other type of energy is known as potential, or energy of position. Thus steam moving with a high velocity, by the nature of its kinetic energy, is enabled to drive the wheels of an impulse turbine. On the other hand, crude petroleum when heated so that it will unite with the oxygen of the air gives out energy in the form of heat, which may be caused to do useful work. The energy inherently latent in the crude petroleum is known then as potential energy. Engineering practice is largely concerned with the harnessing of various forms of energy. Looking about us in nature and in modern engineering accomplishment, we may see numerous instances of energy. The steam engine and steam turbine indicate a form of mechanical energy; the incandescent light, or the dynamo, that of electrical energy; the evolving of heat in the burning of crude oil, that of chemical energy; the human conducting of affairs, that of human energy; the rays of light from the sun, dissipating eternally 10,000 h.p. over each acre of the earth's surface, that of solar energy, and so on indefinitely.

Modern investigation has conclusively established the fact that all types of energy are interchangeable, and though some types of energy are more readily convertible into other types, yet the basic law is true that no energy in sum total is ever destroyed, and on this basis, or law, known as conservation of energy, practically all of our engineering formulas and computations are based.

In the following chapters the conversion of the chemical energy of crude oil into heat energy of the furnace and thence into steam will largely concern our attention. Thus each pound of California crude oil will be found to contain approximately 18,500 B.t.u. of heat energy. This energy of one pound of oil when wholly converted into mechanical energy is sufficient to lift a person weighing 150 lb. through a vertical skyward journey of some 18 miles. Hence the study of the application of such enormous reservoirs of energy, latent in crude petroleum, will prove intensely interesting and instructive.

LETTERS TO THE EDITOR.

Increasing Membership in the Illuminating Engineering Society.

Philadelphia, Pa., February 21, 1914.

Dear Sir:—Because it has a definite message to proclaim, namely, that of better lighting, the Illuminating Engineering Society wishes to enlarge its sphere of influence. It is proposed to increase the membership by two or three hundred members between now and the 1st of July.

It is important however that the members secured should be selected from among those who are really interested in improvements in lighting, so that they do not become mere recipients of the transactions, but seize occasions as they present themselves for expounding the principles of good lighting as they find them set forth by the Society.

Membership at present is not properly balanced geographically being centered too much in the larger cities.

I think it should be our aim to have scattered widely throughout the country, men who through their connection with this Society are able to recognize bad lighting and who will suggest good lighting methods instead. Bad lighting generally exists through ignorance and not through intention.

The human eye is the same in all localities, and it is just as important that the proper illumination of objects it is to see be everywhere accomplished, in the smaller cities and in rural districts as it is in some of the larger cities.

The members desired are those who as wide-awake citizens and alert in the interests of good lighting will see to it, that where an installation is contemplated which bids fair to be atrocious, that proper criticism in the nature of a warning can be given by them, before the money is spent.

We of the illuminating engineering society feel proud of our mission; we feel that no society can hope for an extensive growth unless its membership is enthusiastic and active. The best assurance of enthusiasm is that we are engaged in a helpful and progressive undertaking in which no man need hesitate to join.

"A member may be anyone interested in the objects of the Society."

I wish we could include among our Sections one or more in California before the close of the present year.

We had a council meeting in New York last Thursday and it was very gratifying to those present to note what is being done on the Pacific Coast.

I am also pleased to note the articles you are running on Lighting Methods. Your journal is to be congratulated upon the stand which it is taking on this matter of better lighting. Very sincerely yours,

(Signed) CHAS. O. BOND,
President, Illuminating Engineering Society.

(The Journal will be pleased to supply additional information regarding the Illuminating Engineering Society to all those interested.—The Editors.)

ELECTRIC SMELTING OF ORES AND METALS

With the view of developing more efficient methods in the smelting of ores, the Bureau of Mines began a detailed investigation of the practicability of using the electric furnace as a substitute for or adjunct of the blast furnace, with particular reference to the treatment of low grade ores.

One problem studied is the possibility of using crude oil as a reducing agent. The results of these experiments, which were made by J. F. Cullen under the direction of D. A. Lyon, were incorporated in a report for publication. Another problem, still under investigation, is the possibility of using the electric furnace in the smelting of copper ores, especially sulphides. The experiments incidental to this investigation included work on:

1. The smelting of copper concentrates. Experiments have been made to determine to what degree loss of copper in the slag could be lessened by smelting these concentrates in an electric furnace.

2. The use of the electric furnace in the smelting of nonferreous ores. The purpose of this investigation is to determine the feasibility of using electricity as a source of heat in smelting copper-iron sulphide ores, lean zinc and lead ores, and in fact all low grade ores that are not amenable to treatment by wet methods, and especially to ascertain whether the electric furnace may be used profitably for treating ores from deposits that are so far from a smelter that transportation charges exceed the value of the metals in the ores. In some cases it may be possible to use hydroelectric power in an electric furnace, thus removing the necessity of tarnsporting worthless gangue, and enabling the metals of the ores to be transported as matte or crude metal, providing it was not feasible to refine the metal at the smelting plant.

3. The use of the electric furnace as an aid to the ordinary blast furnace. In the study of this problem the following points have been considered:

(a) The possibility of recovering the iron in the slag as metallic iron. At present, as is well known, although the iron content of a gold, silver, copper, or lead ore may be large, it goes to the dump in the slag, either as iron oxide or iron silicate.

(b) The possibility of producing ferro-silicon from the slags ordinarily obtained in smelting nonferreous ores.

(c) The recovery of the sulphur as a by-product in the smelting of sulphide ores.

(d) The discovery, if possible, of some suitable collector or carrier other than copper and lead for the precious metals in smelting practice.

The purpose of the work has not been to show that the electric furnace should replace reverberatory or the blast furnaces, but that in some places it may be substituted for them. So far only the possibility of treating copper sulphide ores has been studied. The results of the work will be published in a bulletin. The electric furnace work for these investigations has been done by R. M. Keeney, under the direction of D. A. Lyon.

New investigations proposed for the coming year include: The electric smelting of zinc ores; the smelting of titaniferous iron ores; the production of "natural alloys"—that is, the production from complex ores of alloys containing different metals in such proportions as to be of commercial use for structural materials, for tool making, etc.; the use of an electric process for removing moisture from the blast supplied to blast furnaces; the removal of sulphur from producer gas for metallurgical purposes.

The following reports have been or are being prepared for publication:

"The Use of the Electric Furnace in the Manufacture of Iron and Steel," by D. A. Lyon and R. H. Keeney; "The Use of Crude Oil as a Reducing Agent in the Reduction of Iron Ores," by D. A. Lyon and J. F. Cullen; "Smelting of Fine Michigan Copper Concentrates in the Electric Furnace," by R. M. Keeney; "The Use of the Electric Furnace in Metallurgy," by D. A. Lyon, R. M. Keeney and J. F. Cullen; "The Possibility of Smelting Copper Ores in the Electric Furnace," by D. A. Lyon and R. M. Keeney.

These investigations have been carried on by D. A. Lyon, metallurgist, and J. F. Cullen, Electrometallurgist; W. A. Mueller, chemist (from October, 1912, to January, 1913); R. M. Keeney, Electrometallurgist (from February 1, 1913).

LIGHTING WITH THE MERCURY-VAPOR QUARTZ LAMP.

On account of its extremely high efficiency, the quartz lamp has rapidly found a wide application in the lighting field, though its color up to the present time has limited it to industrial work.

On account of the elimination of trimming, lamps can be placed high up and in inaccessible places without the necessity for special runways and platforms. A reasonably wide variation of line voltage is permissible and the lamps can be operated from power circuits without any trouble being experienced.

A few typical installations are tabulated below. These show some of the different classes of work for which quartz lamps are used and the watts per square foot required for satisfactory results.

Quartz Lamp Installation Data.

	Lamps.	Sq. ft. per Lamp.	Watts per sq. ft.	Mounting Height (feet).
Boiler shop	4	4,500	0.16	48
Plate glass manufacture	4	2,330	0.35	35
Mechanical engineering laboratory	7	1,120	0.69	35
Locomotive repair shops	12	2,992	0.25	52
Heavy machine shops	3	3,270	0.23	45
Foundry	2	2,400	0.29	42
Paper mill machine room	2	2,000	0.35	30
Steel construction	72	4,166	0.17	40
Heavy machine shop	2	2,500	0.28	19
Drill hall	8	3,900	0.20	30-40
Foundry and erecting shop	96	3,600	0.21	35-50
Steel punching shop	9	6,880	0.11	35-40
Engine room	3	2,541	0.39	44
Turbine room	7	2,857	0.25	46
Moulding	3	5,700	0.16	35
Engine room	2	3,600	0.22	40

Besides the above, quartz lamps have also been used for smelting and steel works, locomotive works, and, in fact, for all industrial operations where the height necessary for good distribution could be obtained.

The above data is abstracted from a paper by W. A. D. Evans in the January, 1914, transactions, Illuminating Engineering Society.

ELECTRICAL IRRIGATION

IRRIGATION PUMPING WITH ELECTRIC POWER.

BY H. F. McPHAILL.

(The importance and economy of electric pumping for irrigation are referred to, a typical rate for this class of service stated, and several operating costs and data given. This paper was read at the recent Safety Conference, held at Reno, Nevada.—The Editors.)

With the agricultural opportunities offered by Nevada becoming more and more recognized the amount of land capable of being irrigated by gravity systems has been for the most part taken up. With the fertility of the soil undoubted and the climatic conditions most favorable to the growth of crops other means of conveying water to the ground have been brought to public notice. Those being most strongly advocated are artesian wells and power pumping.

Artesian wells having a natural flow above the surface of the ground are very rare so one naturally turns to pumping. In many localities where electrical power is not available, steam and gasoline engines are in use, but it is with electrical power that this article is to deal. Immense areas of Nevada land where lakes, streams or springs are not available for water have a porous gravel sub-formation in which large steady flowing wells may be sunk and pumping plants installed.

Electric pumping plants with a normal degree of efficiency may be relied upon to give an advantage of from 15 to 20 per cent over steam or gasoline plants, where electric power can be secured at reasonable rates. The Truckee River General Electric Company gives the following rates for pumping plants between April 1st and October 1st of each year, the pump being stopped each day during the company's peak load:

First 5000 kw.-hr.....1.7 cents per kw.-hr.
Next 5000 kw.-hr .....1.5 cents per kw.-hr.
Next 20,000 kw.-hr. .....1.3 cents per kw.-hr.
All over 30,000 kw.-hr. .....1.2 cents per kw.-hr.

In case commercial power is not obtainable it would be advantageous for several farmers to combine and install a large common plant at some central point. Power is obtained in this way much cheaper than by several separate small plants.

S. R. Young, owner of the electric plant at Lovelock, successfully irrigates about 500 acres by power pumping and is an enthusiastic advocate of its use.

W. G. Douglas by pumping water from Washoe Lake irrigates about 1000 acres and Ira Winters from the same place irrigates 260 acres. The latter lifts the water 28 ft. with a 10 in. pump of 50 h.p. capacity. He obtains power at the rate of 1½ cents per kw.-hr. and finds the cost of pumping to be 60 cents per acre ft. of water.

At the Martin ranch in Yerington about 300 acres are supplied with water by a 6 in. pump of 10 h.p. capacity. The water is pumped from the Walker river through a lift of 10 ft. and flows from there about a quarter of a mile through a ditch to the point of use. The cost of operation averages about 50 cents per acre foot. These people have other water rights but find it cheaper to pay for power and the cost of operation than to pay the ditch assessment for the other water. For this other water they pay in proportion to the amount turned in at the head of a four mile ditch and of this water about 10 per cent per mile is lost while flowing through the ditch. Plans are now on foot to install a duplicate plant at this place.

Charles Fulstone with a 10 in. pump of 50 h.p. capacity lifts water 38 ft. from a sump in a slough near the Carson River. He irrigates his land for $2.25 per acre with three acre feet of water or at a cost of 75 cents per acre foot. He also intends to put in a duplicate plant.

In other states outside of Nevada thousands and thousands of acres that were formerly worthless land have been made very valuable by means of pumping and more work is being done in this line every year. Irrigation pumping has long since passed out of its experimental stage and will in the future be the means of turning vast areas of Nevada deserts into profitable farms.

Telephone Statistics of the United States prepared for the forthcoming quinquennial report have been given out by Director W. J. Harris of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of W. M. Steuart, chief statistician for manufactures.

The statistics relate to the years ending December 31, 1902, 1907, and 1912. They include the total wire mileage and the total number of telephones reported for all systems in the United States that were in operation all or any part of those years. They do not include private telephone lines used exclusively for communication between different departments of the same establishment unless connected with lines elsewhere through a private or branch exchange. The number of telephones includes all installed, including those furnishing service through private branch exchanges, local pay, and outlying toll stations.

The figures in detail are shown in the following table:

	Year.	Miles of Wire.	Number of telephones.	Estimated number of messages or talks.[1]
Bell Telephone System.	1912	15,133,186	5,087,027	9,133,226,836
	1907	8,947,266	3,132,063	6,401,044,799
	1902	3,387,924	1,317,178	3,074,530,060
All other companies and systems	1912	5,115,140	3,642,565	4,602,431,409
	1907	4,052,098	2,986,515	3,999,389,159
	1902	1,512,527	1,053,866	1,996,024,493
United States..	1912	20,248,326	8,729,592	[2]13,735,658,245
	1907	12,999,364	6,118,578	[2]10,400,433,958
	1902	4,900,451	2,371,044	5,070,554,553

[1] The number of messages reported by the Bell Telephone System includes only completed calls, while the figures for all other companies may include some original calls not necessarily completed; such as calls that the operator reports as "Line busy" or "Does not answer."

[2] Exclusive of companies with an annual income of less than $5000.

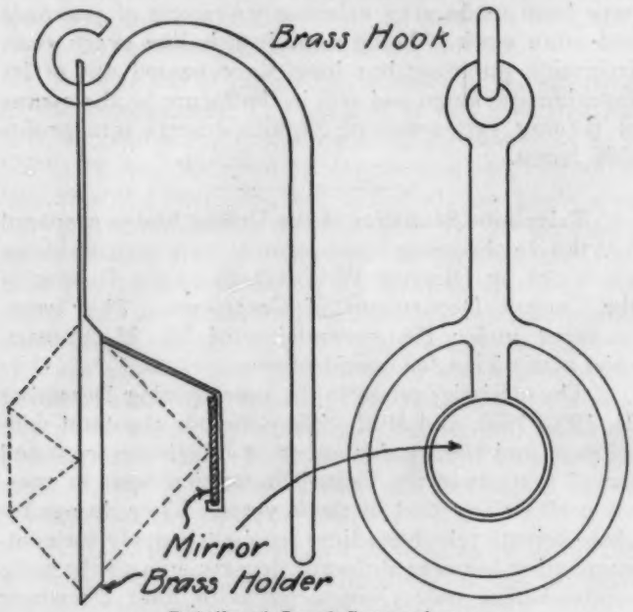
Electrical properties in Japan were, ten years ago, estimated at $14,000,000. During the elapsed period the power produced in Japan advanced from less than 45,000 to over 345,000 kw. It is now roughly estimated that the electrical plants of all kinds represent an investment of about $250,000,000.

LIGHTING METHODS

LIGHTING INSTALLATION PROGRESS, P.P.I.E.

Considerable interest has been centered in the artificial jewels to be used for decorative lighting effects on buildings, and on the Tower of Jewels in the Central Court.

Working drawings are now being made of the device, to be used for suspending these jewels from the various buildings. A metal ring one-eighth inch wide will encompass the jewel on the outer edge at an angle and a second holder at the back will bring a small mirror against the apex of the jewel. It is estimated that by the use of this mirror, the brilliancy of the jewels will be increased more than forty per cent.



Details of Jewel Suspension.

The jewel is hung by small handle with a one-quarter inch hole on a one-eighth inch hook which permits free movement in any direction and which practically amounts to point suspension.

As has been explained before the jewels are molded from an exceptionally hard flint glass in Austria and are afterward farmed out to the peasantry to be hand-cut and polished. The cut is an imitation of a well known diamond cutting.

Complete orders have been placed for all auxliliary equipment required for the operating of the three main d.c. generating stations for the control of d.c. power for exhibitors and decorative lighting.

Experiments are now being made to determine the extent to which it will be advisable to use electrical substitute for fire-work displays. Imitations of waterfalls will be used which will show gold and silver showers in the day time and at night these will be displayed to added advantage under the beams projected from searchlights.

The department is developing a new form of receptacle for use in gala and festival lighting. These are in the form of Mission bells and more than 25,000 will be used in decorative lighting. Special lamps will also be grouped so as to imitate the various forms of fruits and flowers. The lamps to be used in this feature work will be similar to those in common use for Christmas tree lighting.

NEW HIGH EFFICIENCY MAZDA LAMPS.

The new nitrogen filled lamps, which originated in the laboratories of the General Electric Company at Schenectady and which are now being manufactured by the National Lamp Works of General Electric Company under the direction of Mr. J. E. Randall, are to be known as "Mazda" lamps. This is in accordance with a statement published some time ago to the effect that a Mazda lamp would always represent the highest standard of manufacture possible.

The 750 and 1000 watt sizes are now available for 100 to 130 volt multiple service, the efficiency of the smaller lamp being 0.65 watts per candle power and of the larger, 0.60 watts candle power.

These lamps will be furnished in either the regular straight side bulb or round bulb, or in the new style round bulb with long neck.

Dimensions of the bulbs have been standardized and the filament has the same centered position in all styles and in both sizes. Bulbs may vary in size within certain limits, the maximum dimensions being as follows: Length over all (including base) 13½ in.; diameter of bulb, 7 in.; from contact point of base to center of filament, 9½ in., and the over all length less tip of bulb, 13 in.

The filament is concentrated and the spherical reduction factor is therefore high.

Many of the old fields and several new will be opened up for the use of this lamp, which, as with the case of other increased efficiencies, it will be found in the interests of all, to develop.

Precautions.

As the intrinsic brilliancy of the new lamps is so great as to be injurious to the eyes if one looks directly at the lighted lamp for any length of time, enclosing globes of diffusing glass, or indirect fixtures, should always be used unless the lamps are hung so high that they are safely out of the ordinary range of vision. A second precaution that may be observed is to protect the lamps from rain or snow, since water coming in contact with the bulb when the lamp is lighted has been known to crack it. Moreover, no enclosing globes should be used that are not so designed as to ventilate the lamp properly. It will readily be recognized that the continuous conversion of more than one horsepower of electrical energy into heat within the limited space of a lamp bulb would work mischief unless the latter were properly cooled by the outside air.

Other precautions to be taken in installing these lamps were published in a recent issue of this journal.

MONTANA ELECTRIC RAILWAY STATISTICS.

Preliminary figures of the forthcoming quinquennial report on the electric railways of the state of Montana have been given out by Director W. J. Harris of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of W. M. Steuart, chief statistician for manufactures.

The statistics relate to the years ending December 31 for 1912 and 1907, and June 30 for 1902. The totals include electric light plants operated in connection with electric railways and not separable therefrom, but do not include reports of mixed steam and electric railroads nor railways under construction which had not begun operations during the census year.

The figures as presented for Montana show general gains for the decade 1902-1912. There were six operating companies in 1912 as compared with five in 1902. The miles of track numbered 99 in 1912 as compared with 63 in 1902, or an increase of 57 per cent. The persons employed numbered 390 in 1912, as compared with 192 in 1902, or an increase of 103 per cent The revenue passengers carried numbered 15,351,219 in 1912 as compared with 6,858,502 in 1902, or an increase of 124 per cent. The gross income in 1912 amounted to $1,065,597 as compared with $492,023 in 1902, or an increase of 117 per cent. The operating expenses were $770,586 in 1912 as compared with $365,073 in 1902, or an increase of 111 per cent.

The figures are given in detail in the accompanying table:

Montana.

	1912.	1907	1902.	Per cent of increase:[1] 1902-1912.
Number of companies (all operating)	6	5	5	20.0
Miles of line	82.37	57.85	55.19	49.2
Miles of single track	99.22	69.24	63.21	57.0
Cars, number	160	126	109	46.8
Passenger	139	108	90	54.4
All other	21	18	19	10.5
Persons employed	390	251	192	103.1
Salaried employes	39	20	14	178.6
Wage earners (average number)	[2]351	231	178	97.2
Power:				
Horsepower, total	1,520	1,150	1,600	—5.0
Steam and gas engines (including turbines)—				
Number	1	2	4	—75.0
Horsepower	750	1,150	1,350	—44.4
Water wheels—				
Number	3	.....	1	200.0
Horsepower	770	.....	250	208.0
Kilowatt capacity of dynamos	1,070	800	1,143	—6.4
Output of stations, kw.-hr.	1,800,000	([3])	2,128,202	—15.4
Current purchased, kw.-hr.	8,426,574	([3])	([3])	.....
Passengers carried	17,430,364	14,089,649	6,917,002	152.0
Revenue	15,351,219	13,862,231	6,858,502	123.8
Transfer	1,605,849	145,231	58,500	.....
Free	473,296	82,187	.....	.....
Car mileage (passenger, express, freight, etc.)	2,901,249	2,422,477	7,354,822	114.1
Condensed income acct.:				
Gross income[4]	$1,065,597	$902,621	$492,023	116.6
Operating expenses	$770,586	$551,933	$365,073	111.1
Gross income, less operating expenses	$295,011	$350,688	$126,950	132.4
Deductions from income (taxes and fixed charges)	$224,729	$120,851	$74,633	201.1
Net income	$70,282	$229,837	$52,317	34.3

[1] A minus sign (—) denotes decrease.

[2] Number employed Sept. 16, 1912.

[3] Figures not available.

[4] Income from sale of current for light and power included: In 1912, $242,305; in 1907, $77,993; and in 1902, $43,284.

MONTANA CENTRAL STATION STATISTICS.

These statistics relate to the years ending December 31 for 1912 and 1907, and June 30 for 1902, and cover both commercial and municipal electric plants. They do not include electric plants operated by mining companies, factories, hotels, etc., which consume the current generated, those operated by the Federal government and state institutions, or plants that were idle or in course of construction.

The figures as presented for Montana show substantial gains for the decade 1902-1912. The commercial establishments numbered 27 in 1912 and 26 in 1902. The total income amounted to $3,883,410 in 1912 as compared with $1,025,971 in 1902, or an increase of 279 per cent. The total expenses amounted to $2,411,668 in 1912 as compared with $660,476 in 1902, or an increase of 265 per cent. The total number of persons employed was 514 in 1912 as compared with 202 in 1902, or an increase of 155 per cent. The total horsepower of the engines (including auxiliary engines) was 12,825 in 1912 as compared with 7887 in 1902, or an increase of 63 per cent. The horsepower of the water wheels increased from 24,000 in 1902 to 102,885 in 1912, or 329 per cent. The output of stations in 1912 amounted to 379,212,617 kilowatt hours as compared with 36,435,766 in 1902, or an increase of 941 per cent. The estimated number of arc lamps wired for service in 1912 was 2193 as compared with 1648 in 1902, or an increase of 33 per cent. All other varieties of lamps wired for service, however, numbered 388,718 in 1912 as compared with 101,868 in 1902, or an increase of 282 per cent. The horsepower capacity of stationary motors served with electric current was 75,184 in 1912 as compared with 1401 in 1902, or an increase of 5267 per cent.

The figures are shown in detail in the accompanying table:

Montana.

	1912.	1907.	1902.	Per cent of increase: 1902-1912.
Number of establishments	29	33	27	7.4
Commercial	27	31	26	3.8
Municipal	2	2	1	100.0
Income[1]	$3,883,410	$2,469,131	$1,025,971	278.5
Light, heat and power	$3,292,385	$2,376,472	$1,017,805	223.5
All other sources	$591,025	$92,659	$8,166	7,137.6
Total expenses, including salaries and wages	$2,411,668	$1,469,808	$660,476	265.1
Total number of persons employed	514	319	202	154.5
Total horsepower	115,710	68,817	31,887	262.9
Steam and gas engines (including turbines):				
Number	39	31	26	50.0
Horsepower	12,825	11,830	7,787	64.7
Water wheels:				
Number	64	62	44	45.5
Horsepower	102,885	56,987	24,000	328.7
Auxiliary engines:				
Number	([2])	.....	5	.....
Horsepower	([2])	.....	100	.....
Kw. capacity of dynamos	74,398	39,602	22,055	237.3
Output of stations, kw.-hr.	379,212,617	137,379,261	36,435,766	940.8
Estimated number of lamps wired for service:				
Arc	2,193	[3]3,123	1,648	33.1
All other varieties	388,718	[3]231,201	101,868	281.6
Stationary motors served:				
Number	1,962	971	151	1,199.3
H.P. capacity	75,184	33,240	1,401	5,266.5

[1] Exclusive of $242,305 in 1912, $77,993 in 1907, and $43,284 in 1902 reported by street and electric railway companies as income from sale of electric current for light or power or from sale of current to other public service corporations.

[2] Not reported separately.

[3] Exclusive of 68 arc and 2507 lamps of other varieties reported by the electric companies as used to light their own properties. Lamps used for such service were included in the number reported for 1912.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advanace of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Precipitation of Cement Dust 219
By Philip S. Taylor.
Electrical Atmospheric Charges 223
Elements of Fuel Oil Practice and Boiler Testing 224
By Robt. Sibley.
Letters to the Editor 225
Electric Smelting of Ores and Metals 226
Lighting With the Mercury Vapor Quartz Lamp 226
Irrigation Pumping With Electric Power 227
By H. F. McPhaill.
Telephone Statistics of the United States 227
Electrical Properties in Japan 227
Lighting Installation Progress P. P. I. E 228
New High Efficiency Mazda Lamps 228
Montana Electric Railway Statistics 229
Montana Central Station Statistics 229
Editorial 230
A Critic Criticized.
Imperative Improvements.
Lighting Legislation.
Personals 232
Meeting Notices 233
Electrical Jobbers at Del Monte 233
News of California Railroad Commission 234
Idaho Public Utilities Commission 234
Trade Notes 234
Industrial 235
Electrification of the Butte, Anaconda & Pacific R'y.
A Catalogue De Luxe 237
News Notes 238

A Critic Criticized

Not a week passes but there is brought to our attention, articles reprinted in other periodicals from this journal, in whole generally and sometimes in part, without due credit being given to us as the original publishers of the copyrighted articles so used.

This is bad enough, and some of the purloining periodicals have, under pressure, promised future action in accordance with the ethics of the publishing business, but this appropriating has now taken on a more subtle form.

An esteemed contemporary condenses the essentials of one of our recent editorial writings into a rather lengthy paragraph, and then goes on to say that the ideas suggested are a result of an attempt to focus attention upon the subject by supply dealers, jobbers and a few lamp manufacturers.

Seeing that there are only "a few lamp manufacturers," we are pleased to note that our contemporary considers that the ideas which we suggested and which originated in our editorial rooms, represent the combined opinions of several important branches of the electrical industry.

We would point out to our contemporary that it was not advocated that central stations should "cease to exercise supervision over the lamps connected to their circuits." But in view of the fact that "the Public Service Commission law gives the commission explicit supervision over the efficiency of the electric incandescent lamps supplied," if this indeed be so, then there is no reason why central stations should sell lamps, at cost or otherwise, in order to ensure "that the public receive the very best lamps of highest efficiency at minimum expense." The remedy, apparently, lies elsewhere.

This may be dismissed with the statement that the privilege of those who cannot meet arguments is to resort to ridicule.

But it will take more than ridicule to alter the fact that discrimination does exist whenever a central station sells any commodity at cost or at less than a fair profit, and that to the extent that this is done the business of legitimate electric supply houses is injured.

The argument is advanced, notwithstanding the admitted protection afforded consumers from other sources, that "central stations have experienced the necessity of testing the lamps being supplied to customers and would not leave the consumers without this safeguard." In refuting such a stand it need only be said that not one thousandth of one per cent of the lamps sold by central stations are tested by them for quality; that the only "test" which they do receive is one to show that the lamp will light. Every dealer does this for his own protection.

That a central station may sell electric lamps and appliances as "part of the service they render," is a

condition which no one particularly desires to eliminate.

The points to be made are, that control of lamp sales by the central station is not essential in the interests of their customers; that sales of lamps and appliances at cost or at less than a fair profit shows discrimination and should be eliminated; that the competition from such central station sales should not be unfair; and incidentally, that if others must use the ideas or articles published in this journal, we would prefer that they give us credit for them, even though they think that we are wrong.

Imperative Improvements

The article in this issue on the electrical precipitation of cement dust emphasizes the fact that necessity must often kick men from behind before they will make that progress which is best for their own interests, and for those of their neighbors. Necessity is still the mother of invention.

It is also of value as a description of the successful utilization of some of the more recent scientific discoveries the practical application of which have heretofore been impossible due to the lack of the necessary auxiliary apparatus.

That in the early stages the saving in product is found to be sufficient to offset the cost of removing this nuisance of dust falling upon the surrounding country, augurs well for the future more profitable use of such systems.

Foreign matter escaping into the air whether in the form of fine cement dust, or smoke, may be injurious to health, to plant life or to the appearance of the country side, as well as damaging to property. It is generally offensive and a cause of discomfort.

Scientists have been, and are, attacking from many angles the problem of keeping the air comparatively free from such impurities.

Hydroelectric development of the West has been hampered and electrical energy is not therefore available for general fuel purposes. In many places less favored than the West, it is probable that such a desirable circumstance of heat without vitiation or pollution of the air will not be realized from the utilization of this "white coal."

For them the problem is being attacked differently and experimental plants are already in operation which distil coal at low temperatures and thus produce a smokeless fuel for domestic purposes; the yield also containing many other valuable products, such as fertilizer, fuel oil, and so forth.

Fuel oil, used carelessly, constitutes perhaps one of the greatest nuisances, for the dense smoke, which is also obnoxious, contains an oily soot as well.

In this connection it is worthy of note that the nuisances sometimes represent enormous losses to those responsible for them. The removal of the nuisance would result profitably to them. In some large cities the cost of the smoke nuisance alone, expressed as a per capita loss, is as high as nine dollars.

The system described in this issue has been applied to the collection of carbon smoke and a number of installations have also been made in smelters where the economic possibilities are enormous.

As a record of accomplishment, the article is of more than passing interest, and points clearly to even greater possibilities, and to opportunities over which the inventive could profitably ponder.

Lighting Legislation

Practically every general article on the subject of illumination mentions the continually increasing brilliancy of lamp filaments necessitating the equipment of modern lamps with diffusing glassware or with some opaque reflector which, inverted, directs the light to the ceiling or over some other relatively large surface, thus reducing the brilliancy of those light giving areas, primary or secondary, which come within the range of vision.

Much of the lighting equipment in use today, is an outgrowth of those years when either candle sticks or oil lamps were the portable forms of lighting apparatus used and the chandeliers were necessarily installed within reach that the candles might be conveniently lighted or snuffed, if required.

The fundamental considerations upon which good lighting depends, do not always enter into the planning or installation of modern electroliers and electric portables.

Then there are those purchasers who can never be told anything to their good. They who see in the earnest appeal of the expert lighting salesman, an attempt merely to increase the first cost. The resulting installation, made with cheapness as a criterion and based upon ignorance, rarely embodies any of the essential requirements, and a lighting installation which is a menace to eyesight, results.

This was true of the carbon filament lamp and more so of the later high efficiency metal filament lamps, the careless use of which but barely escaped being a crime.

Now the advent of the new nitrogen filled metal filament lamp of even greater brilliancy, calls for scientific installation—the use of adequate equipment.

But you cannot teach your "cheap" purchaser and as a result, lighting legislation must follow.

Whatever laws are made regarding the use of lamps of great brilliancy should, however, be based upon the most expert knowledge that they be clearly and scientifically stated, so that there shall be no question, as was the case with the headlight laws of various states, as to their correct interpretation.

To this end, sections of the Illuminating Engineering Society, with a membership composed of those interested in the science and art of illumination become centers of sane influence which might accomplish much toward the passage of the most effective local laws. This should serve to further stimulate active interest in this society.

In this issue is a letter from Mr. C. O. Bond, president of the Illuminating Engineering Society to which the attention of readers is particularly directed.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Thos. Mirk, president, Hunt, Mirk & Company, San Francisco, is a visitor at Los Angeles.

N. E. Cheney has been appointed Alternate Jovian Statesman at Seattle, Washington.

Fred B. Fressen, representing the Luminous Unit Company of St. Louis, is at Salt Lake City.

Geo. A. Campbell, general manager, Truckee River General Electric Company, is at San Francisco from Reno.

L. Arbogast of the Newbery Bendheim Electric Company, Los Angeles, was at San Francisco during the past week.

F. W. Mielenz, manager, Napa Valley Electric Company, St. Helena, Cal., was one of the visitors at San Francisco this week.

W. W. Hanscom, consulting engineer, San Francisco, was recently elected a member of the Illuminating Engineering Society.

Harry Adams, Phillips Insulated Wire Company, Pawtucket, R. I., is calling on the Pacific Coast trade and is now at San Francisco.

Louis R. Krumm, radio expert, connected with the wireless telegraph bureau of the United States Treasury Department, is at San Francisco.

Samuel Insull, president of the Commonwealth Edison Company, Chicago, Ill., is visiting Pacific Coast cities and is at present at Pasadena, Cal.

Arthur Walser, district manager motor department, General Electric Company, Denver, Colorado, is making a trip through the Salt Lake district.

Ernest F. Schettler, chief clerk of the Intermountain Electric Company of Salt Lake City, is back at his desk after being confined at his home by sickness.

W. W. Torrence, local manager of General Electric Company at Salt Lake City, left last week for Schenectady on his regular general visit to the home office.

C. L. Hull, foreman standardizing laboratory, General Electric Company, San Francisco, has left for a six weeks' trip to the company's works at Schenectady.

R. C. Heaton, until recently with the Washington Electric & Manufacturing Company, is now connected with the Home Electric Company of Tacoma, Wash.

W. M. Deming, general sales manager General Electric Company, Schenectady, attended the Del Monte electrical jobbers' convention and is now at San Francisco.

R. H. Sperling, general manager, British Columbia Electric Railway Company, Vancouver, B. C., is at present visiting Southern California accompanied by Mrs. Sperling.

L. A. Osborn, vice-president Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., attended the Pacific Coast Electrical Jobbers' convention at Del Monte.

Curtis B. Hawley, president and general manager of the Intermountain Electric Company, has returned from an extended eastern trip during which he attended the Jobbers' Convention.

A. D. Page, sales manager, Edison Lamp Works of General Electric Company, Harrison, N. J., was a visitor at the recent convention of the Pacific Coast Electrical Jobbers held at Del Monte.

Fred F. Skeel, sales manager, Crouse, Hinds Company, Chicago, Ill., was one of the eastern visitors at the Del Monte convention of the Pacific Coast Electrical Jobbers and is now at Los Angeles.

J. F. NePage and **V. S. McKenny** of the firm of Ne Page, McKenny & Company, Seattle, were at San Francisco last week in connection with the city hall contract. They also visited Los Angeles.

D. F. McGee, chief engineer of the Pacific Power & Light Company, Portland, Oregon, has been promoted to the position of assistant to the president of the Electric Bond & Share Company, New York, N. Y.

E. A. Wilcox, Twelfth Mars, was responsible for a most successful rejuvenation of the Jovian Order held at Twin Falls on Saturday, February 28th, under his direction. Sixteen initiates were taken into the order.

Walter Cary, vice-president and general manager, Westinghouse Lamp Company, Pittsburg, Pa., was at San Francisco during the past week after having attended the Del Monte convention of the Pacific Coast Electrical Jobbers.

O. F. Swenson has been appointed manager of the new offices opened by Hunt, Mirk & Company, Engineers and Contractors, San Francisco, in the Alaska Building, Seattle, Wash., and will have charge of the company's business in the Pacific Northwest.

G. N. Barker has been elected chairman of the Portland Section, National Electric Light Association; **Chas. P. Osborne**, vice chairman; **R. L. Carroll**, treasurer; **C. C. Craig**, **L. A. McArthur**, and **O. B. Coldwell**, members of executive committee, and **B. Goodwin**, secretary.

B. H. Scranton, president American Electric Heater Company, Detroit, Mich., and **Frank Kuhn**, vice-president of the company, now en route to Portland and Seattle, were visitors at the convention of Pacific Coast Electrical Jobbers, held at Del Monte during the latter part of last week.

C. S. Walton, **A. Petsch**, **Fawcett Robinson**, **W. G. Hutchinson**, **E. R. Northmore**, **J. B. Wheeler**, **L. O. Lieber**, and **R. H. Manahan** have been appointed members of the Los Angeles committee on electrical display for 1915. This committee is to interest merchants and property holders in appropriate decorative lighting effects for exposition year.

Van Rensselaer Lansingh, who has been appointed manager of a recently organized department in the National Lamp Works of General Electric Company, with offices at the National Lamp Works, Nela Park, Cleveland, will have general supervision over the manufacture and sale of reflectors both glass and metal.

Mr. Lansingh has been prominent in the activities of the Illuminating Engineering Society, in fact was one of its founders. He was general secretary in 1906 and president for the term ending in December, 1912. Since then Mr. Lansingh has also served as treasurer, vice-president and president and is perhaps in the minds of central station men more closely identified with the advancement of scientific principles in regard to the use of reflectors of light sources than any other man in this country. Mr. Lansingh in July, 1900, formed the V. R. Lansingh Company in Chicago, sales agents for Holophane globes and reflectors. In September, 1904, he was appointed general manager and chief engineer of the Holophane Works of General Electric Company, Cleveland, the headquarters of which have recently been located in that city. Mr. Lansingh has very frequently contributed to the proceedings of the Illuminating Engineering Society and to the technical press of this and other countries. The progress made by the Illuminating Engineering Society during the past year has been considerable, much of which is due to Mr. Lansingh, who can always be depended upon in committee work not only to do his share, but to see that those under him have a strong working interest in the results sought.

MEETING NOTICES.

Portland Sections A. I. E. E. and N. E. L. A.

Mr. Paul Lebenbaum's paper on the "Electrification of the Portland, Eugene & Eastern Railroad," was thoroughly enjoyed by everyone present and called forth more discussion than any paper so far presented. The attendance was 125.

Seattle Jovian League.

The Jovians of Seattle held their weekly luncheon at the Lincoln Hotel Friday, March 6th, at 12:30 p. m. The after-dinner speaker was Mr. Carl Bush of the A. G. Company who spoke on the improvements that have recently been made by the company he represents in iron boxes and protective devices.

Portland Electrical League Luncheon.

At the regular Wednesday luncheon held in the Blue Room of the Multnomah Hotel, Portland, Ore., motion pictures were shown of the construction of the Northwestern Electric Company's steam and electric underground generating and distributing system. Also a film showing the methods used to transport the 50 ton steam turbine from the freight yards to the power station.

San Francisco Electrical Development and Jovian League.

A business meeting was held at the usual place this week. After considerable discussion the proposed amendment to the constitution providing for bi-monthly meetings in lieu of the present weekly meetings was held over for one month. A motion was carried to the effect that the Society for Electrical Development Inc., be requested to advise the league as to the campaign which they intend to follow on the Pacific Coast. Other matters of interest to the league were also discussed.

Utah Electric Club.

At the weekly luncheon of the Utah Electric Club at the Commercial Club Thursday, March 5th, Miss Mary Alisparo and Miss Josephine Betts, employes of the Mountain States Telephone & Telegraph Company, furnished a musical program while luncheon was being served.

The talk of the day was given by Dorsey A. Lyon, acting chief metallurgist of the U. S. Bureau of Mines, on the subject: "The Electric Furnace, and Its Application in Electro-Chemistry and Electro-Metallurgy."

The Society for Electrical Development.

New York, March 12th, 1914.—The Executive Committee met yesterday and activities of the Society were thoroughly discussed. The following committee, which is to meet March 17th, has been appointed to decide on final plans and to put them into effect: Henry L. Doherty, New York; W. H. Boynton, Cleveland; George Williams, New York; J. Robert Crouse, Cleveland; W. E. Robertson, Buffalo; E. W. Lloyd, Chicago; F. H. Gale, Schenectady; J. C. McQuiston, Pittsburg; J. R. Strong, New York; J. M. Wakeman, and S. L. Coles.

Jovian Electrical League of Southern California.

The members to the number of 100 were addressed at their weekly luncheon on March 4th, by ex-Senator R. F. DelValle, president of the board of public service commission. This interesting "native son" and descendant of a distinguished Spanish family talked most entertainingly for a half hour on "Hospitality" at the time of the Dons and at present and related a number of his early personal experiences which were highly appreciated by the audience.

In response to a telegram to Mr. Edison, congratulating him on the occasion of his 67th birthday on February 12th last, the following autograph letter was received by Chairman Colkitt from Mr. Edison:

"Dear Mr. Colkitt:—Allow me to express my thanks to you and to the Jovians of Los Angeles and to the members of the Jovian Electrical League for your kind congratulations on my birthday. I appreciate very greatly your courteous remembrance of the occasion. Yours very truly,

(Signed) THOMAS A. EDISON.

ELECTRIC JOBBERS AT DEL MONTE.

The Pacific Coast Electrical Supply Jobbers' Association and their guests held a most successful and pleasant meeting at Del Monte, California, March 5, 6 and 7. The attendance was over seventy and included a number of notables from the East.

One of these, W. W. Low, president of the Electric Appliance Company of Chicago, carried off the principal honors in the golf tournament, winning the Patton, the Jobbers' and the Del Monte cups with a gross score of 114 strokes and a handicap of —18.

In the Manufacturers' tournament F. H. Murray of the National Carbon Company won the manufacturers' and the Del Monte cups with a gross of 120 and a handicap of —18. The pool tournament was won by F. N. Averill of the Fobes Supply Company.

The presence of sixteen ladies added greatly to the enjoyment of the occasion and in addition to automobile rides, dances and other amusements, a putting contest was held for their edification. This was won by Mrs. Walter H. Seaver. Mrs. W. W. Low was the winner in the bridge game and Mrs. H. B. Squires in the 500 game.

At the general meeting on Saturday afternoon, W. W. Low discussed the business difficulties of the jobber. In the course of a clear-cut analysis of the cost of conducting a jobbing business, he showed that the percentage of profit on many articles was not sufficient to meet this cost. His remarks constituted a strong plea for sane merchandising of electrical goods. In the discussion that followed, W. L. Goodwin contended that prices should be based upon the cost of handling. Fred Skeel stated that there can be a profit only when price is based on cost. C. E. Wiggin cited some interesting facts and W. S. Berry showed how jobbing costs could be reduced by allowing the small dealers to sell to central stations, electric railways, and so forth. W. L. Goodwin further questioned the practice of differential prices to contractors and fixture dealers, contending that every man who buys for re-sale should have the same profit.

Chairman H. V. Carter also brought up the subject of the Society for Electric Development, calling upon W. W. Low for a statement as to its work. Mr. Low stated the organization had started its active campaign on the 1st of March, and was preparing a series of articles for the trade publications in different industries, and was also working to establish more harmonious relations between the central station and the contractor. A. D. Page of the Edison Lamp Works of the General Electric Company stated that the directors and officers of the society have underwritten the amount necessary to complete the $200,000 minimum fund, with which this campaign is being launched. He also outlined the lamp companies' practice in selling lamps direct to the consumer and in determining the proper cost of merchandising lamps. A. H. Halloran told of the proposed work of the society on the Pacific Coast.

The regular golf dinner was held on Saturday evening, with W. W. Leggett as toastmaster. The various trophies were presented to the victors, and a hearty welcome extended to the Eastern visitors.

The following were in attendance:

Jobbers.

F. N. Averill, Fobes Supply Company, Portland, Ore.
Harry Byrne, North Coast Elec. Company, Seattle, Wash.
W. S. Berry, Western Elec. Company, San Francisco.
T. E. Burger, Western Elec. Company, San Francisco.
C. H. Carter, Pacific States Elec. Company, Los Angeles.
H. V. Carter, Pacific States Elec. Company, San Francisco.
J. I. Colwell, Western Elec. Company, Seattle, Wash.
Albert H. Elliot, Secretary, San Francisco.
W. S. Goodwin, Pacific States Elec. Company, San Francisco.
C. L. Gilson, Gilson Elec. Company, Oakland, Cal.
C. B. Hall, Illinois Elec. Co., Los Angeles.
R. D. Holabird, Holabird, Reynolds Elec. Co., San Francisco.
Ross Hartley, Pacific States Elec. Company, Portland, Ore.
C. C. Hillis, Elec. Appliance Company, San Francisco.
F. N. Killam, Pacific States Elec. Company, Seattle, Wash.
F. H. Leggett, Western Elec. Company, San Francisco.
W. W. Low, Elec. Appliance Company, Chicago, Ill.

Duncan Reynolds, Holabird, Reynolds Elec. Co., Los Angeles.
Samuel Taylor, Elec. Ry. & Mfs. Sup. Co., San Francisco.
C. E. Wiggin, Dunham, Carrigan & Hayden Company, San Francisco.

Ladies.

Mrs. T. E. Bibbins	Mrs. C. E. Heise
Mrs. W. S. Berry	Mrs. F. H. Leggett
Mrs. A. H. Elliot	Mrs. Harold Lauritzen
Miss Elliot	Mrs. R. F. Oakes
Mrs. S. B. Gregory	Mrs. Duncan Reynolds
Mrs. A. H. Halloran	Mrs. W. H. Seaver
Mrs. J. H. Herr	Mrs. H. E. Sanderson
Mrs. C. C. Hillis	Mrs. H. B. Squires

Manufacturers.

Adams, Harry, Phillips Ins. Wire Co., Pawtucket, R. I.
Alvord, R. M., General Electric Co., San Francisco.
Bibbins, T. E., General Electric Co., San Francisco.
Cary, Walter, Westinghouse Lamp Works, Pittsburgh.
Case, J. O., General Electric Co., Los Angeles.
Cole, John R., John R. Cole Co., San Francisco.
Colwell, J. I. Western Electric Co., Seattle, Wash.
Cott, W. A., General Electric Co., Los Angeles.
Deming, W. M., General Electric Co., Schenectady.
Davis, R. J., Van Emon Elevator Co., San Francisco.
Fagan, Frank, General Electric Co., San Francisco.
Gregory, S. B., Arrow Electric Co., San Francisco.
Hills, Chas. L., Franklin Electric Lamp Co., New York.
Hall, W. Brewster, Pass & Seymour, San Francisco.
Herr, J. A., Sprague Electric Works, San Francisco.
Halloran, A. H., Journal of Electricity, San Francisco.
Heise, C. E., Westinghouse Elec. & Mfg. Co., San Francisco.
Kirkland, H. B., American Conduit Mfg. Co., Pittsburgh.
Kumler, Frank, General Electric Co., Portland.
Kuhn, Frank, American Electric Heating Co., Detroit.
Lauritzen, Harold, Holophane Works, San Francisco.
Murray, F. H., National Carbon Co., Los Angeles.
Moody, A. S., General Electric Co., Portland.
Morris, J. M., Westinghouse Elec. & Mfg. Co., Los Angeles.
Oakes, R. F., American Everready Co., San Francisco.
Osborne, L. A., Westinghouse Elec. & Mfg. Co., Pittsburgh.
Page, A. D., Edison Lamp Works, Harrison, N. J.
Poss, Fred, Benjamin Electric Co., San Francisco.
Pounder, W. R., Hubbard & Co., San Francisco.
Plank, H. E., General Electric Co., Seattle.
Quinn, Frank, Manhattan Elec. Supply Co., San Francisco.
Russell, S. P., H. W. Johns-Manville Co., San Francisco.
Seaver, W. H., American Steel & Wire Co., San Francisco.
Sanderson, H. E., Bryant Electric Co., San Francisco.
Squires, H. B., H. B. Squires Co., San Francisco.
Skeel, Fred, Crouse-Hinds Co., Chicago.
Scranton, D. H., American Electric Heating Co., Detroit.
Vandegrift, J. A., Oakland Warehouse Co., Oakland.
Zorn, F. J., General Electric Co., Seattle.

NEWS OF THE CALIFORNIA RAILROAD COMMISSION.

The Hermosa Beach Water Company has filed an application with the commission asking permission to withdraw from the territory embraced within the limits of the city of Manhattan Beach, Los Angeles county. The city of Manhattan Beach voted a bond issue of $116,000 with which to construct a municipal waterworks, and according to the application, has declined to negotiate for the purchase of the applicant's property.

The city of Claremont, Los Angeles county, has transferred the jurisdiction over its public utilities to the railroad commisison.

The San Joaquin Light & Power Corporation has applied to the commission for authority to issue $3,145,000 of bonds for the purpose of refunding underlying bonds. The company also asks for authority to refund $200,000 in short term notes.

The Southern Counties Gas Company applied to the commission for authority to issue $115,000 in bonds and to use the proceeds for the purpose of building a pipe line from the natural gas fields in the Olinda District, Orange county, to serve the cities of Placentia, Fullerton, Anaheim, Olive, Orange, McPherson, El Modena, Santa Ana, Garden Grove and Tustin. The company also asks for authority to refund notes in the sum of $16,000.

The Western States Gas & Electric Company has filed an application with the Railroad Commission for authority to issue $219,000 first mortgage refunding five per cent gold bonds which the applicant wishes to sell at eighty-two and one half per cent.

The commission has granted the application of the Central California Gas Company to issue bonds of the face value of twelve thousand dollars, bearing six per cent per annum, under the terms of its general mortgage to the Los Angeles Trust & Savings Bank; and also one thousand three hundred dollars of preferred stock and twelve thousand five hundred dollars common stock.

IDAHO PUBLIC UTILITIES COMMISSION.

The commission found that the Beaver River Power Company had not obtained from the commission a certificate of public convenience and necessity covering the sale of energy for light and power purposes in the city of Pocatello. The Beaver River Power Company had commenced construction of a distribution system under a franchise granted by the city. This was found by the commission to be in contravention of the state laws, and the company was ordered to immediately discontinue construction until further ordered.

The Northern Idaho & Montana Power Company was permitted to establish flat rates for electric lighting on less than statutory notice requirements, providing for a combination heating and power rate for laundries of 2½ cents per kw.-hr., subject to a discount of 10 per cent and to a monthly minimum rate of $2 per connected kw. The order was granted, and the rate became effective at once.

The Washington Water Power Company was similarly permitted to establish flat rates for electric lighting in the Coeur d'Alene Mining District of Northern Idaho, to apply to remote and isolated districts.

The Kootenai Power Company, Limited, was permitted by the commission to file a new schedule of rates, applying to the city of Coeur d'Alene. These were ordered effective as from March 1st.

The Idaho-Oregon Light & Power Company was permitted to file at less than statutory notice, a complete schedule which materially reduces the rates and charges heretofore made by the company. These changes were also made effective as from March 1, 1914.

The commission ordered that the Idaho Power & Light Company refrain from further constructing its distribution system in the city of Twin Falls, and that it refrain from furnished any consumer in the city of Twin Falls any electrical energy until further ordered.

TRADE NOTES.

The Bowie Switch Company, Nevada Bank Building, San Francisco, has been appointed selling agents for Flint & Walling Manufacturing Company, Kendallville, Ind., manufacturers of transmission line towers and special steel equipment.

Orders for the remainder of the electrical apparatus to be used in P. P. I. E. buildings and on the grounds, will be placed soon. The draughting department is now making a final check of lists to determine the quality and character of apparatus required.

The plans and specifications for the electrical work for the California Building are almost completed. The contract for the electrical work in the Court of Palms and the Court of Flowers has been awarded to Newbery Bendheim Electric Company.

An order was placed during the past week with the Wheeler Reflector Company, Boston, Mass, for 2154 steel reflectors varying in size from 7 to 11 in., to be used at the P. P. I. E. They are to be lacquered aluminum finish and will be used in the various exhibit palaces.

At the Panama-Pacific Exposition, to be held at San Francisco, in 1915, the National Lamp Works of General Electric Company will have a space 90 ft. by 20 ft. in which the most modern methods of feeding factory employes will be demonstrated by Mr. L. H. Brittin, manager of the company's general service department, and assistants. As evidenced by the award of the grand prize at the recent International Exhibit of Factory Safety and Sanitation Devices in New York City, the National Lamp Works' system of factory betterment work is now generally recognized as one of the most successful and most scientifically planned of any that has thus far been developed.

INDUSTRIAL

ELECTRIFICATION OF THE BUTTE, ANACONDA & PACIFIC RAILWAY.

The Butte, Anaconda & Pacific Railway is, in many ways, the most remarkable example of steam road electrification in this country. Besides being the first 2400 volt direct current road, it is also credited with being the first steam road operating both freight and passenger schedules, to electrify its lines purely for reasons of economy. A number of steam railway electrifications have been made because of preemptory factors, such as terminal and tunnel operation or for rapid suburban service. This road, however, cannot be classed as an "enforced electrification," since no such special limitations have been the determining factors.

The first electric locomotives were put in service on this line May 28, 1913. During the first seven months of service, they made approximately 201,000 miles and hauled about 2,365,000 tons of ore.

The steam locomotive crews consisting of engineman and fireman easily acquired proficiency in handling the electric locomotives; in fact, two or three days' instructions from a competent electrical man were ordinarily sufficient. The change from steam to electric haulage was made without any change in the personnel of the train crews and without any delays or alterations in the schedule. The engineers, without exception, have expressed themselves as being greatly pleased with the easy operation of the locomotives.

The electrified lines of this system extend from the Butte Hill yard to the smelter, a distance of 32 miles. There are numerous sidings, yards, and smelter tracks that have been equipped with overhead trolley, making a total of about 95 miles on a single track basis.

The Butte, Anaconda & Pacific Railway is essentially an ore hauling road, the freight traffic from this source originating at the copper mines located near the top of Butte Hill. The main line division extends through a rough mountainous country, a distance of about twenty miles, with grades as high as 0.3 per cent. The east bound traffic consists in returning empty cars to the mines and the transportation of copper ingot to the Butte yards, where it is shipped over other roads to refineries.

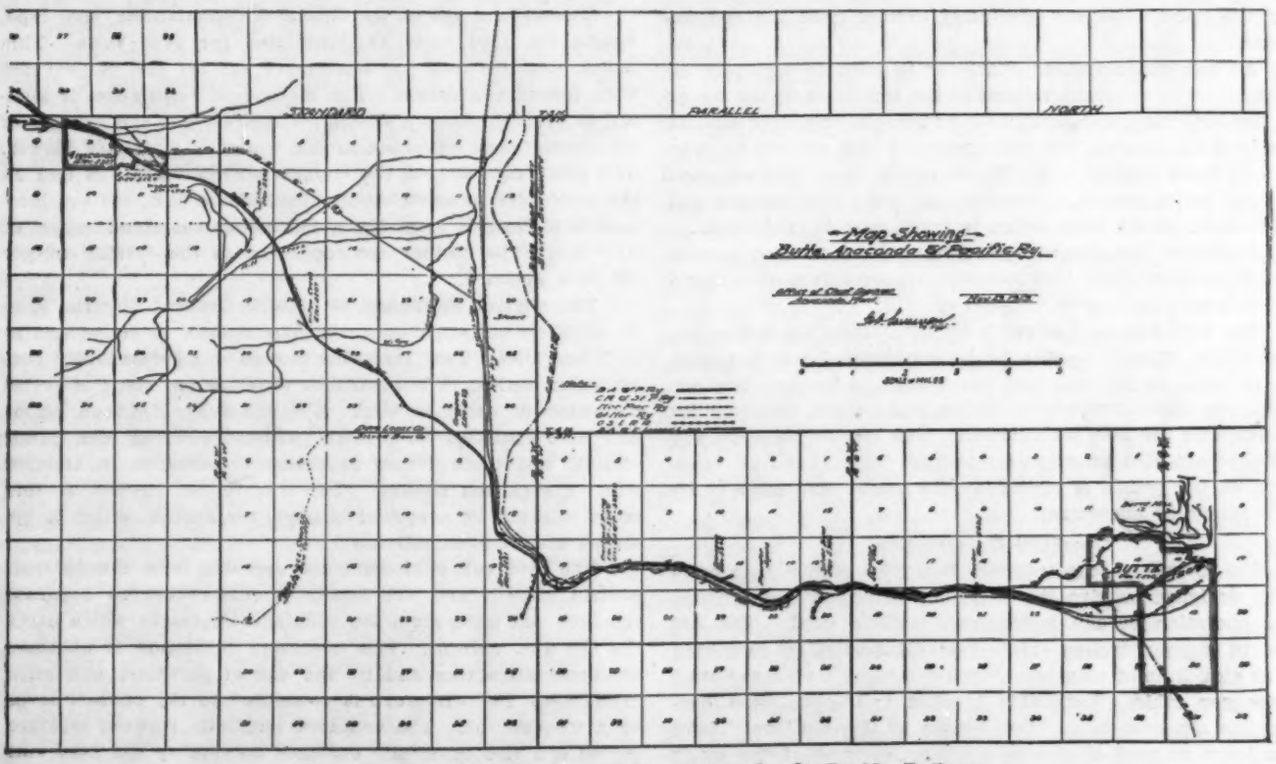
Between the cities of Butte and Anaconda there is considerable local traffic, both passenger and freight. At Butte, the Butte, Anaconda & Pacific connects with the Great Northern Railway, the Northern Pacific, and the Chicago, Milwaukee & St. Paul Railroad; and at Silver Bow, about six miles from the city, connection is made with the Oregon Short Line.

For a distance of 16 miles, the Butte, Anaconda & Pacific Railway is paralleled by the transcontinental lines of the Northern Pacific, and the Chicago, Milwaukee & St. Paul. The last named company has already contracted for power for the operation of electric trains from Harlowton, Montana, to Avery, Idaho, a distance of 440 miles.

The maximum curvature on the system (20 degrees, 285 ft. radius) occurs on the Butte Hill line. On this part of the road, there is an average curvature of 6 to 10 degrees. The locomotives are designed with sufficient flexibility to take a curve of 31 degrees (180 ft. radius) at slow speed.

Condensed Information of Freight Movement.

	West Bound.			East Bound.		
	Butte Hill Line.	Main Line.	Smelter Hill.	Smelter Hill.	Main Line.	Butte Hill Line.
Trailing load in tons..	2000	4000	1400	1000	1260	650
Number of cars.....	30	60	20	55	70	35
Number of 80-ton locomotives per train ...	2	2	2	2	2	2
Approx. grade against load	2.5%	0.3%	1.1%	1.1%	1%	2.5%
Approx. speed on level tangent track, m.p.h.		21			25	
Approx. speed on Max. grade	12	16	16	20	16	16
Average trolley voltage	2200	2200	2200	2200	2200	2200
Length of run in miles.	4.6	20.1	7	7	20.1	4.6



Map of Electrified Section,—Butte, Anaconda & Pacific Railway.

Single locomotives are used, hauling trains of from three to five passenger and baggage cars.

Energy for the operation of electric trains is purchased from the Great Falls Power Company. The generating plant is located at Great Falls, Mont., on the Missouri River, and has for some time been supplying electric power for the operation of the mines and smelters at Butte and Anaconda. Six hydroelectric units are installed, having a nominal rated capacity of 21,000 kw. The machines are of the horizontal type, generating 6600 volts, 3-phase, at a frequency of 60 cycles. The power is stepped up to 102,000 volts for transmission to the transformer substation at Butte, a distance of 130 miles, over two separate parallel lines constructed on the same right-of-way. An extension of the system transmits power at 60,000 volts to a second transformer station at Anaconda, 26 miles farther on.

The Butte station forms the center of the extensive power system operated by the Montana Power Company. Besides the Great Falls 102,000 volt transmission lines, there are several 60,000 volt transmissions terminating at this point, which form a part of the Montana Power Company's system. These lines bring in power from the Hauser Lake, Canyon Ferry, Madison and Big Hole plants. At the Butte substation, this power is stepped down to 2400 volts, 3-phase, and all of these lines are tied in on the 2400 volt a.c. bus. Ample protection is therefore afforded from the interruption of service.

The two existing substations at Butte and Anaconda were used to house the 2400 volt motor-generator sets required for operating the electric trains, so that no additional buildings were constructed for this purpose. Power is furnished by two 1000 kw., 3-unit motor-generator sets in each substation, taking power from the 2400 volt a.c. buses. These units operate continuously 24 hours per day, seven days of the week, to supply the necessary current for train operation. Each set consists of a 3-phase, 60 cycle, 1450 k.v.a, 720 r.p.m. synchronous motor direct connected to two 500 kw., 1200 volt generators, insulated to operate in series for 2400 volts. The generators are compound wound and have both commutating poles and compensating pole face windings. These fields are connected on the grounded side of the armature, and the main fields are separately excited from 125 volt exciters.

An automatic voltage regulator is used to maintain an approximately constant voltage at the terminals of the motor by power factor regulation. The motors are protected against overload by inverse time limit relays, which are set to open at four times normal load. These relays have been adjusted to open under sustained overload in about two seconds and upon short circuit their action is practically instantaneous.

Excitation for the two generating units in each substation is obtained from two induction motor driven sets, rated 50 kw. each at 125 volts.

The 2400 volt switchboards for controlling these sets are first direct current boards to be constructed for this high the voltage. In general, they are similar to the standard 600 volt types with increased insulation and special provision for interrupting the 2400 volt current. The circuit breakers and switches are also arranged for remote control, and all apparatus on the panels is provided with ample insulation to insure safety to operators.

Overhead Construction.

The overhead construction for this system was especially designed to give the flexibility necessary for satisfactory operation of the pantograph trolleys used. The 4/0 grooved copper trolley used over all tracks is supported by an eleven point catenary suspension from a stranded steel messenger cable. Both side bracket and cross span construction are used as required by the local conditions. There is a large amount of special work on account of the many yards and sidings, and in one case twelve tracks are spanned.

The alternating current switchboard contains two panels for controlling the synchronous motors by means of remote The cross span construction used at this point is supported by a third pole between the eighth and ninth tracks. The hanger used on the straight line construction is a rolled steel strap looped over the messenger wire. This loop is closed at the car and the wire is clamped in place by a single bolt. Special pull-offs are used to increase the flexibility of the suspension.

The section breakers were designed for the 2400 volt service, and at six points insulated crossings are necessary at the intersection of the 2400 volt trolley with the 600 volt trolley of the city system. On the main line a very simple section insulator is used. This consists of paralleling the two trolley wires from the ends of each section at a suitable distance for insulation so that the pantograph bridges the two circuits for a short distance, thus avoiding interruption of the power supply to the locomotive. The construction in the yards and sidings is simplified by paralleling the trolley from the side tracks for a short distance along the main line. This avoids the use of switch plates or similar devices. At some of these junction points the pantograph engages as many as six trolley wires.

The overhead lines are protected from lightning by 2400 volt d.c. type ME arresters installed on poles at intervals of one-third of a mile the entire length of the system.

Locomotives.

The locomotive equipment consists of seventeen (17) 80 ton units, fifteen for the freight and two for passenger service. The freight locomotives are geared for slow speed and are operated in pairs for the main line service. The maximum free running speed is 35 m.p.h.

The two passenger locomotives of the same construction are geared for a maximum free running speed of 55 m.p.h. A speed of 45 m.p.h. is made with three passenger coaches on straight level track.

A continuous tractive effort of a single 80 ton freight locomotive is 25,000 lb. at 15 miles per hour. The maximum tractive effort for a period of five minutes is 48,000 lb. based on a tractive coefficient of 30 per cent.

The motors are of the GE-229-A commutating pole type, wound for 1200 volts and insulated for 2400 volts. This motor was designed for locomotive service and is provided with forced ventilation. The method of ventilation is similar to the well known ventilated motors, but the volume of air circulated is increased by the use of an auxiliary blower. The gear reduction on the freight locomotive is 4.84 and on the passenger locomotive 3.2. The double unit, 160 ton locomotive is capable of giving a continuous sustained output of 2100 h.p. The motors are connected to the driving wheels by twin gears.

The control equipment is Sprague-General Electric Type M, multiple unit, operating the four motors in series and in series-parallel. Two 1200 volt motors are permanently connected in series. The controller provides ten steps in series and nine in series-parallel. The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The transfer of circuits at this point is made by a special change-over switch, which is operated electro-pneumatically.

The 2400 volt contactors are operated from the 600 volt control circuit, and are specially constructed to separate the 2400 volt parts from the coils and interlocks which carry the 600 volt current. The necessary insulation is obtained by large clearances and by the use of porcelain and mica insulation. The armature is connected to the contact lever by a wooden rod. The contacts, magnetic blowout and arc chutes are also especially designed to rupture the 2400 volt arc.

Two Unit Electric Locomotive Hauling Freight Train.

Current is collected by overhead roller pantographs, pneumatically operated and controlled from either engineer's compartment by an air valve. A 2400 volt insulated bus line runs along the center of the cab roof. These bus lines are connected together by couplers between the two freight units, so that current may be obtained from either one or two collectors. The air brakes are the combined straight and automatic type; and the compressor is of the CP-26, 600 volt type, having a piston displacement of 100 cu. ft. of air per minute when pumping against a tank pressure of 135 pounds. Radiating pipes are provided on the roof of the cab for reducing the temperature of the compressed air before it reaches the high pressure cylinder.

For operating the control equipment and air compressor and for lighting the locomotive and cars, 600 volt current is supplied from the 2400/600 volt dynamotor installed on each locomotive.

The load furnished by the direct connected blower supplies sufficient current in the series field windings to provide for the necessary excitation, so that no shunt windings are required. The blower which supplies ventilating air to the motors consists of a multivane fan mounted on an extension of the dynamotor shaft. It has a capacity of 7200 cu. ft. per minute at 4 in. pressure.

The principal data and dimensions applying to the locomotives are the following:

Electric Locomotive Data.

Length inside of knuckles	37 ft. 4 in.
Length over cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width overall	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Track gauge	4 ft. 8½ in.
Total weight	160,000 lb.
Weight per axle	40,000 lb.
Wheels, steel tired	46 in.
Journals	6 in.x13 in.
Gears, forged rims, freight locomotives	87 teeth.
Gears, forged rims, passenger locomotives	80 teeth.
Pinions, forged, freight locomotives	18 teeth.
Pinions, forged, passenger locomotives	25 teeth.
Tractive effort at 30 per cent coefficient	48,000 lb.
Tractive effort at one hour rating	30,000 lb.
Tractive effort at continuous rating	25,000 lb.

The locomotives have been maintained by the regular shop force with the assistance of one man experienced in electrical apparatus.

Standard 600 volt lighting fixtures are used on the cars, and each passenger and baggage coach wired for five groups of five lamps in series. The lights in each car are controlled by a suitable master switch and fuse with snap switches in the individual circuits. Thirty-six watt railway type Mazda lamps are used, giving about 26 c.p. at 110 volts per lamp. Lighting current will be taken from a 600 volt train line bus, which is connected to the dynamotor on the locomotives.

All of the passenger and baggage cars now used between Butte and Anaconda will be heated as well as lighted by electricity as soon as the equipment can be installed.

All apparatus for the electrification of this road was furnished by the General Electric Company of Schnectady, New York.

A CATALOGUE DE LUXE.

The Crouse-Hinds Company of Syracuse, N. Y. has just issued Catalog No. 1000 on Condulets, which sets what is believed to be the highest standard ever reached in a trade publication. This 200 page, cloth bound volume, 9 by 12 in., is magnificently printed in four colors on heavily coated stock. A complete illustrated description of every kind of device manufactured by the company is conveniently shown in its natural colors, brass screws, copper contacts and aluminum covers being as distinct as cast iron bases.

This text opens with a three-way pictorial index, its 18 pages giving a complete display of the line. The index is arranged alphabetically as to types, numerically as to families and pictorially as to uses. The catalogue constitutes a liberal education for any electrical contractor or supply man. Its merits and novelties are so numerous that only a few can be mentioned here.

In addition to the standard lines of condulets have been added a full line of covers and fittings which will take any number of switches or receptacles. A new type of service entrance condulets provided with protective fuses and a padlock is shown for the first time. Two pages are devoted to a complete list of makes of fittings which can be used with condulets. Much space is devoted to bodies with "obround" and elliptical openings as well as to condulets which can be used under water and in places where destructive vapors abound. Among the thousands of new lines listed are a complete line of housings for railway work, both steam and electric. Fixtures complying with the U. S. postal requirements are fully illustrated together with a complete line to care for police, wire and marine requirement, as well as portable telephone systems for railway dispatching. Other valuable features are the house numbering fixtures and a pilot light for electric ironing circuits.

The description in each case gives shipping weight, size of standard package and list price, together with information as to installation. This monumental work has only to be seen to be appreciated.

NEWS NOTES

INCORPORATIONS.

TONOPAH, NEV.—Articles incorporating the Colorado River Hydroelectric Company, with principal offices located at Tonopah, have been filed. The capital is $5,000,000 and the incorporators are Henry C. Schmidt, W. R. Williams, and William Forman of Tonopah. This is the company which recently secured valuable water rights on the Colorado River near the Nevada line, with the intention of harnessing a portion of the flow of the river to create and supply power to southern Nevada and Arizona.

ILLUMINATION.

GLOBE, ARIZ.—The city council has decided to place petitions in circulation to secure signatures in favor of an election to determine whether or not to construct a municipal electric light plant.

GLENDALE, CAL.—The board of trustees will receive bids up to March 16 for furnishing material and installation of a lighting system in Ornamental District No. 3, and Ornamental District No. 4 in the city of Glendale.

GLENDORA, CAL.—A franchise has been awarded to the Pacific Light & Power Company granting right to construct and maintains for 40 years, an electric pole and wire system for lighting and power purposes in Glendora.

HOMEDALE, IDAHO.—The Homedale Water, Light & Power Company has petitioned the public utilities commission for a certificate of public convenience and necessity to enable it to furnish this city with light and water for domestic, fire, sprinkling, sanitary and other general uses. The company is incorporated for $50,000.

PHOENIX, ARIZ.—With preliminary steps now under way and assurance from the United States reclamation service that electric power can be secured from them in any quantity and at minimum rates municipal ownership of the electric lighting and gas system of Tempe seems assured. The proposition will be submitted to the voters in the form of a bond election in the near future.

SEATTLE, WASH.—Suit was begun in the federal court recently by the Olympic Foundry Company against the Westerman Iron Works, alleging infringement of a patent on the five-light cluster lamp post design invented in 1910 by J. D. Ross, superintendent of lighting, and demanding an accounting of all the ornamental electric street lamp posts manufactured by the defendant. The foundry company claims, by virtue of an assignment from Mr. Ross, an exclusive half interest in the patent.

SALT LAKE CITY, UTAH.—A special committee consisting of twenty-two prominent club women representing the Association of City Clubs, have been investigating conditions in Salt Lake City school buildings and have made numerous recommendations to the board of education with reference to the improvement of this feature of the public school system. Among these is included the suggestion that many class rooms are inadequately lighted, and that the board of education either provide an adequate system of illumination for these rooms, or that they be abandoned for class purposes. They recommend that a vacuum cleaner system be installed in the new high school building and in all other school buildings, and that adequate systems of forced ventilation be installed wherever necessary. It is interesting to note that in most of the recommendations of this committee, electricity offers a solution of the difficulties encountered which it is desired to remove.

RIVERSIDE, CAL.—The city council at its next meeting will recommend a reduction in electric rates that provides, among other alterations, from established schedules, the lowest schedule for industrial power that has so far been filed with the state railroad commission by any corporation supplying power for this purpose. The board of public utilities, after long deliberation over a revision in the schedule for lighting and power rates, is now ready to submit its recommendations, which are as follows:

METER RATES FOR LIGHTING.

First 150 kw.-hr. per mo.	7c per kw.-hr.
Next 100 kw.-hr. per mo.	6c per kw.-hr.
All additional, per mo.	4c per kw.-hr.

DOMESTIC POWER RATES.

First 500 kw.-hr. per mo.	3c per kw.-hr.
All additional, per mo.	2c per kw.-hr.

PUMPING RATES.

First 100 kw.-hr. per mo.	1½c per kw.-hr.
Next 100 kw.-hr per mo.	1 4-10c per kw.-hr.
All additional, per mo.	1¼c per kw.-hr.

TRANSMISSION.

CANBY, ORE.—M. J. Lee of this city will build a $25,000 power plant near Molalla this spring. All the machinery required has been purchased and work will begin immediately.

SOUTH PASADENA, CAL.—January, 1921, has been set as the final date for the elimination of poles and wires from the streets of South Pasadena, according to an ordinance passed recently.

LOS ANGELES, CAL.—The council has adopted the proposal of the special power committee that the negotiations be broken off with the power companies. Steps are now being taken to hold an election at the earliest possible date for the people to vote on a $6,500,000 bond issue to be utilized for the purposes of completing the power plant, the interest cost of which to the city is now stated to be $4000 per day, and for the acquisition or construction of a distributing system.

PORTLAND, ORE.—The stockholders of the Northwestern Electric Company will hold a special meeting on April 8th, to authorize an increase of the capital stock of the company to 120,000 shares at a par value of $100 a share, making a total capitalization of $12,000,000. Of this amount, 20,000 shares, representing $2,000,000 capital, will be preferred stock, bearing interest at 6 per cent a year. The trustees of the company are Herbert Fleishhacker, M. Fleishhacker and R. E. Wallace.

TRANSPORTATION.

OAKLAND, CAL.—The stockholders of the Oakland, Antioch & Eastern Railway Company at a special meeting ratified an issue of $700,000 4 year 6 per cent convertible notes.

OAKLAND, CAL.—Rejecting all offers of compromise the Albany board of trustees has demanded the forfeiture of $5000 by the Oakland Traction Company for failure to construct the Albany extension within the time granted in the franchise of 1910.

BLYTHE, CAL.—A new electric railroad through the Parker Indian Reservation, the survey for which is now being made, will probably be built in the near future. The line will run from Parker, Arizona, to Ehrenberg, with possible extensions into Palo Verde valley and Cibola valley.

NORTH YAKIMA, WASH.—The North Yakima & Valley Railway will build an extension of seven miles in the Cowiche to the Tieton postoffice and will extend the reservation branch to White Swan this year, according to Superintendent J. O. Roth. The work will cost about $300,000. Improvements of existing lines will cost about $30,000.

PASADENA, CAL.—D. J. McPherson, engineer, engaged by the city to make the preliminary survey for the proposed municipal railway between Pasadena and Los Angeles via Arroya Sedro Canyon, has submitted his report to the city commissioners. According to the report, the cost will be $2,089,164 to build and equip the line, which will be 10 miles long.

SEATTLE, WASH.—That there has been a noticeable improvement in business conditions for the first two months of 1914 over the same period of last year, is indicated by the revenues of the Puget Sound Traction, Light & Power Company for the month of January, showing an increase for that period of $23,190.81, with but four lines showing less receipts than for January of last year and every other line showing a substantial increase.

SALT LAKE CITY, UTAH.—The Utah Light & Railway Company has gotten out a neat button bearing on its face the company's monogram and the words "Safety First." These buttons are presented by the company to the members of the "Safety First" committee, consisting of twenty-five employes of the company. This committee is changed at regular intervals. The retiring members retain their buttons, thus becoming ex-officio members of the Safety Committee.

PORTLAND, ORE.—Geo. F. Heusner plans to begin the immediate construction of the railway line outlined in the franchise which was granted him last fall. This calls for the construction of a single or double track broad gauge railway line from the city boundary at Patton avenue, near the approach to the proposed interstate bridge across the Columbia, and on various streets to the Broadway bridge, and on the west side it will loop Flanders, Tenth, Salmon and Fourth streets.

SAN FRANCISCO, CAL.—Plans are being considered for the private construction of a street railway to Hunter's Point to connect with the projected Potrero extension of the Municipal Railroad and to be operated by the syndicate of capitalists who have recently purchased 275 acres of waterfront land near the site of the naval base which the government is to establish at Hunter's Point. The capitalists who are interested in the project are C. de Guigne Jr., A. Schilling, H. T. McCloskey, C. O. Miller, F. W. Van Sicklen and Fred Morgan. They propose to build a trolley line about 1½ miles long from Hunter's Point to the Twenty-fifth street terminal of the municipal line, and to turn their line over to the city for operation as a part of the Municipal Railway. It is estimated that the Hunter's Point line will cost about $100,000. It will run principally over a private right of way.

SAN FRANCISCO, CAL.—The Public Utilities Committee of the supervisors has approved an ordinance directing the construction of the municipal railway lines included in the bond issue voted last year. Plans are ordered and the board of works is authorized to obtain bids. The lines are set forth as contemplated last year, with the exception of the Church street road, which is to built only to Dorland street. The War Department has been assured by the utilities committee that the municipal railway will be built through the Fort Mason reservation to the transport docks. The committee approved the United Railroads' new car plans, which resemble those for the new municipal railway cars. The United Railroads will order 65 new cars as soon as authorized by the railroad commission. The board of works has received bids for installing underground and overhead electric conductors for the Union street line. The lowest for the underground is that of the Pacific Gas & Electric Company, amounting to $5785, and the lowest for the overhead is the Pacific Fire Extinguisher Company's for $3200.

TELEPHONE AND TELEGRAPH.

YUMA, ARIZ.—There is a movement on foot to establish a telephone system in San Pascual valley. The instigators of the plan have in mind an independent company with the Bell Company of Yuma.

NEWPORT BEACH, CAL.—The board of trustees has advertised for sale a 50 year telephone franchise, to be sold April 20, by the terms of which the telephone company is to furnish free telephones to the city and pay the city 2 per cent of the gross income.

LA JOLLA, CAL.—The Pacific Telephone & Telegraph Company has leased the store room at 939 Wall street for a local exchange. Work will begin about April 1st on the installation of a new switchboard and business will begin in the new quarters about May 1.

SAN FRANCISCO, CAL.—The stockholders of the Pacific Telephone & Telegraph Company have elected the following directors: J. C. Ainsworth, E. C. Bradley, J. C. Cebrian, Wm. H. Crocker, F. G. Drum, F. W. Eaton, M. Ehrman, G. D. Greenwood, Timothy Hopkins, Homer S. King, Walter S. Martin, G. E. McFarland, H. D. Pillsbury, J. M. Quay, H. T. Scott, O. J. Woodward and Theo. N. Vail. The directors organized by electing the following officers: Henry T. Scott, chairman of the board; G. E. McFarland, president; H. D. Pillsbury and J. M. Quay, vice-presidents; F. W. Eaton, secretary and treasurer; F. C. Phelps, general auditor. The executive board is composed of Wm. H. Crocker, F. G. Drum, F. W. Eaton, Timothy Hopkins, Homer S. King, G. E. McFarland and Henry T. Scott, chairman.

WATERWORKS.

MILTON, ORE.—March 26th has been set as the date for voting on a $18,000 for the increasing of the light plans and the extension of the water system.

PORTLAND, ORE.—The commissioner of public utilities has been granted authority to advertise for bids and let the contract for 5000 water meters. The installation of meters is to begin at the rate of 1000 per month after April 1st.

EUGENE, ORE.—The Eugene water board has taken an option on a half block of land on College Hill on which to build one of the two reservoirs to be included in the improvements made this coming summer with the $100,000 to be derived from the bond sale. Work will start about April 1st on the water system.

SAN DIEGO, CAL.—Notice of appropriation of all waters of San Dieguito and San Ysabel rivers or waters to the extent of 10,000 miners' inches, has been filed with the county recorder by H. Taylor, who intends to construct a solid dam 150 ft. high across San Dieguito River and divert the water thus stored by means of pipes and flumes to adjacent lands.

BRAWLEY, CAL.—A resolution has been adopted by the board of trustees determining that public interest demands the acquisition and construction of municipal improvements to the water system, the cost of which is estimated at $35,000, and a bond election will be held soon to vote on the question of incurring a bonded indebtedness in this amount.

SAN DIEGO, CAL.—The water department's advisory committee, of which Rufus Choate, George W. Marston and Simon Levi are members, has recommended that the construction of a conduit between Morena dam and Barrett Intake be constructed by public contract. The estimated cost of the conduit is $185,000.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 American Ever-Ready Co.....
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-1 Benjamin Electric Manufacturing Co.....
Rialto Building, San Francisco.

B-2 Berkeley Electric Cooker Co.....
1932 Center Street, Berkeley.

B-3 Blake Signal and Manufacturing Co..... 4
680 Howard Street, San Francisco.

B-5 Bridgeport Brass Co..... 3
(See Pierson, Roeding & Co.)

C-1 Century Electric Co.....16
614 So. Grand Ave., Los Angeles; Salt Lake City; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-2 Crocker-Wheeler Co.....11
Title Insurance Bldg., Los Angeles; Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-3 Cutler-Hammer Manufacturing Co.....
579 Howard Street, San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-1 D. & W. Fuse Co.....
(All Jobbers.)

D-2 Dearborn Drug and Chemical Works 11
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
(See General Electric Company.)

E-2 Edison Storage Battery Supply Co.....11
441 Golden Gate Avenue, San Francisco.

E-3 Electric Agencies Co.....
247 Minna Street, San Francisco.

E-4 Electric Storage Battery Co.....
Pacific Electric Building, Los Angeles; Spalding Building, Portland; 118 New Montgomery Street, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

F-1 Fairbanks, Morse & Co.....
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 Fort Wayne Electric Works of G. E. Co.....12
Rialto Building, San Francisco; Colman Building, Seattle.

G-1 General Electric Co..... 13-14
124 W. Fourth Street, Los Angeles; Worcester Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Paulsen Building, Spokane.

H-1 Habirshaw Wire Co.....
(See Western Electric Company.)

H-2 Hemingray Glass Co.....11
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-3 Hoagland-Hulse Electric Co.....
1707 Naud Street, Los Angeles.

H-4 Hunt, Mirk & Co.....
141 Second Street, San Francisco.

I-1 Indiana Rubber and Insulated Wire Co.....16
807 Mission Street, San Francisco.

K-1 Kellogg Switchboard and Supply Co.....
Aronson Building, San Francisco.

K-2 Keystone Boiler Works.....
201 Folsom Street, San Francisco

K-3 Klein & Sons, Mathias..... 5
579 Howard Street, San Francisco.

K-4 K-P-F Electric Co.....11
37 Stevenson Street, San Francisco.

L-1 Leahy Manufacturing Co.....
Eighth and Alameda Streets, Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 3
(See Pierson, Roeding & Co.)

M-1 Mannesmannrohren-Werke 5
Rialto Building, San Francisco.

M-2 McGlauflin Manufacturing Co.....
Sunnyvale.

M-3 Moore & Co., Charles C.....
Van Nuys Building, Los Angeles; Spalding Building, Portland; Kearns Building, Salt Lake City; 40 First Street, San Francisco; Mutual Life Building, Seattle; Santa Rita Hotel Building, Tucson.

N-1 Nason & Co., R. N.....
151 Potrero Avenue, San Francisco.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Building, Los Angeles; Rialto Building, San Francisco.

N-3 National Lamp Works of G. E. Co.....15
(All Jobbers.)

N-4 New York Insulated Wire Co.....
629 Howard Street, San Francisco.

N-5 Norris Co., L. A. .....
Monadnock Building, San Francisco.

O-1 Okonite Co. 16
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.....
80 Tehama Street, San Francisco.

P-2 Pacific States Electric Co..... 2
526 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 526 Thirteenth Street, Oakland; 575 Mission Street, San Francisco; 307 First Ave., So., Seattle.

P-3 Parker Boiler Co.....
201 Folsom Street, San Francisco.

P-4 Pelton Water Wheel Co.....11
2219 Harrison Street, San Francisco.

P-5 Pierson, Roeding & Co..... 3-4
Pacific Electric Building, Los Angeles; Spalding Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

P-7 Pittsburg Piping & Equipment Co.....16
Monadnock Building, San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The.....
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-2 Simonds Machinery Co.....
12 Natoma Street, San Francisco.

S-3 Simplex Electric Heating Co.....16
612 Howard Street, San Francisco.

S-4 Southern Pacific Co..... 4-11
Flood Building, San Francisco.

S-5 Sprague Electric Works of G. E. Co.....16
Rialto Building, San Francisco; Colman Building, Seattle.

S-6 Standard Underground Cable Co.....
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Yeon Bldg., Portland, Or.; Central Bldg., Seattle, Wash.

S-7 Staples & Pfeiffer.....
102 Steuart Street, San Francisco.

T-1 Thomas & Co., R.....
(See Western Electric Co.)

V-1 Van Emon Elevator Co.....
56 Natoma Street, San Francisco.

W-1 Wagner Electric Manufacturing Co..... 5
Rialto Building, San Francisco.

W-2 Western Electric Co.....
119 East Seventh Street, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 1518 First Avenue, So., Seattle.

W-3 Westinghouse-Church-Kerr Co.....
Pacific Electric Building, Los Angeles; Pacific Building, San Francisco.

W-4 Westinghouse Electric and Manufacturing Co..... 6
50-52 East Broadway, Butte; Van Nuys Building, Los Angeles; Couch Building, Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Central Building, Seattle; Paulsen Building, Spokane.

W-5 Westinghouse Machine Co.....
141 Second Street, San Francisco.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric and Manufacturing Co.)

W-7 Weston Electrical Instrument Co..... 3
682 Mission Street, San Francisco.

W-8 Western Pipe & Steel Co.....
444 Market Street, San Francisco; 1758 North Broadway, Los Angeles.